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WATER TYPE AND SUITABILITY OF OKLAHOMA SURFACE WATERS FOR PUBLIC SUPPLY AND IRRIGATION

PART 1: ARKANSAS RIVER MAINSTEM AND VERDIGRIS, NEOSHO, AND ILLINOIS RIVER BASINS THROUGH 1978

U.S. GEOLOGICAL SURVEY
WATER-RESOURCES INVESTIGATIONS 81-33

Prepared in cooperation with the
OKLAHOMA WATER RESOURCES BOARD

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

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Water-quality data in the Arkansas River mainstem and the Verdigris, Neosho, and Illnois River basins are examined for water type and suitability for public water supply and for irrigation use. The classification of water type is based on the relation of the major ions -- calcium, magnesium, sodium, bicarbonate/carbonate, sulfate, and chloride -- to each other within the range of measured specific conductance. The evaluation of suitability for use as a public supply is based on the concentration levels and distribution of selected constituents. The Wilcox irrigation classification scheme is used to relate sodium concentrations and the salinity distribution to the use of the water for irrigation. The possibility of boron phytotoxic effects is discussed where data are available.

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Prepared in cooperation with the
OKLAHOMA WATER RESOURCES BOARD

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CONVERSION FACTORS

Inch-pound units used in this report may be converted to the International System of Units (SI) by the following conversions factors.

Multiply inch-pound unit	By	To obtain SI unit
Foot (ft)	0.3048	Meter
Mile (mi)	1.609	Kilometer
Square mile (mi^2)	2.590	Square kilometer
Degree Fahrenheit (°F)	((°F)-32) 5/9	Degree Celsius

WATER TYPE AND SUITABILITY OF OKLAHOMA SURFACE WATERS FOR PUBLIC SUPPLY AND IRRIGATION

PART 1: ARKANSAS RIVER MAINSTEM AND VERDIGRIS, NEOSHO, AND ILLINOIS RIVER BASINS THROUGH 1978

By Jerry D. Stoner

ABSTRACT

Water-quality data in the Arkansas River mainstem and the Verdigris, Neosho, and Illinois River basins within Oklahoma through 1978 were examined for water type and suitability for public water supply and for irrigation use. Of 147 stations with available data, 68 stations or 46 percent were considered to have sufficient data for analysis. The classification of water type was based on the relation of the major ions: calcium, magnesium, sodium, carbonate, bicarbonate, sulfate, and chloride to each other within the range of measured specific conductance. The suitability for use as a public supply was based on the concentration distribution of selected constituents. The constituents selected were those with maximum contaminant levels established by regulation, or constituents for which recommended maximum limits have been established and for which historical data are available. The irrigation classification method of Wilcox was used to relate sodium, calcium, and magnesium concentrations and the salinity distribution to the use of the water for irrigation. Where data were available, the chance of phytotoxic effects by boron was discussed.

INTRODUCTION

Surface-water-quality data for Oklahoma have been collected and published on a regular basis for the past 30 years. These data represent 2,733 station-years of record from 527 stations (Stoner, 1977). These data consist of tabulations of water-quality analyses of varying suites of constituents, but the data are not readily usable to water planners and managers. The purpose of this report is to summarize the data at selected stations to provide information on water type, water-quality trends, and suitability for use as public and irrigation supplies. A water-quality report on selected Oklahoma surface waters that is of a more general statistical nature has recently been published (Kurklin, 1979). A statistical summary of streamflow records is provided in a report by Mize (1975), therefore, streamflow data were not included in this report.

ACKNOWLEDGMENTS

Water-quality data in Oklahoma have been collected and published on a cooperative basis with many Federal, State, county, district, and city agencies during the past 30 years. Two of the principal cooperators are the Oklahoma Water Resources Board and the U.S. Army Corps of Engineers. The author thanks all of the agencies, past and present, for their part in the collection of surface-water-quality data in Oklahoma.

STATION SELECTION

The stations included in this report were selected using two criteria. First, stations listed in the report by Stoner (1977) were eliminated if less than 10 samples had been collected and if the stations had not been operated during 1976-78. Statistical analysis of data from less than 10 samples generally is inadequate to determine frequencies and variations during the annual hydrologic cycle. Second, only data in the U.S. Geological Survey's WATSTORE (National Water Data Storage and Retrieval System) were used. WATSTORE was accessed for each station to determine data availability. A deletion of stations was made from WATSTORE information using the same criterion of less than 10 samples. Very few of the selected stations had 10 analyses for each of the selected water-quality constituents. Most of the stations lacked data on the toxic metals -- arsenic, cadmium, chromium, lead, and mercury.

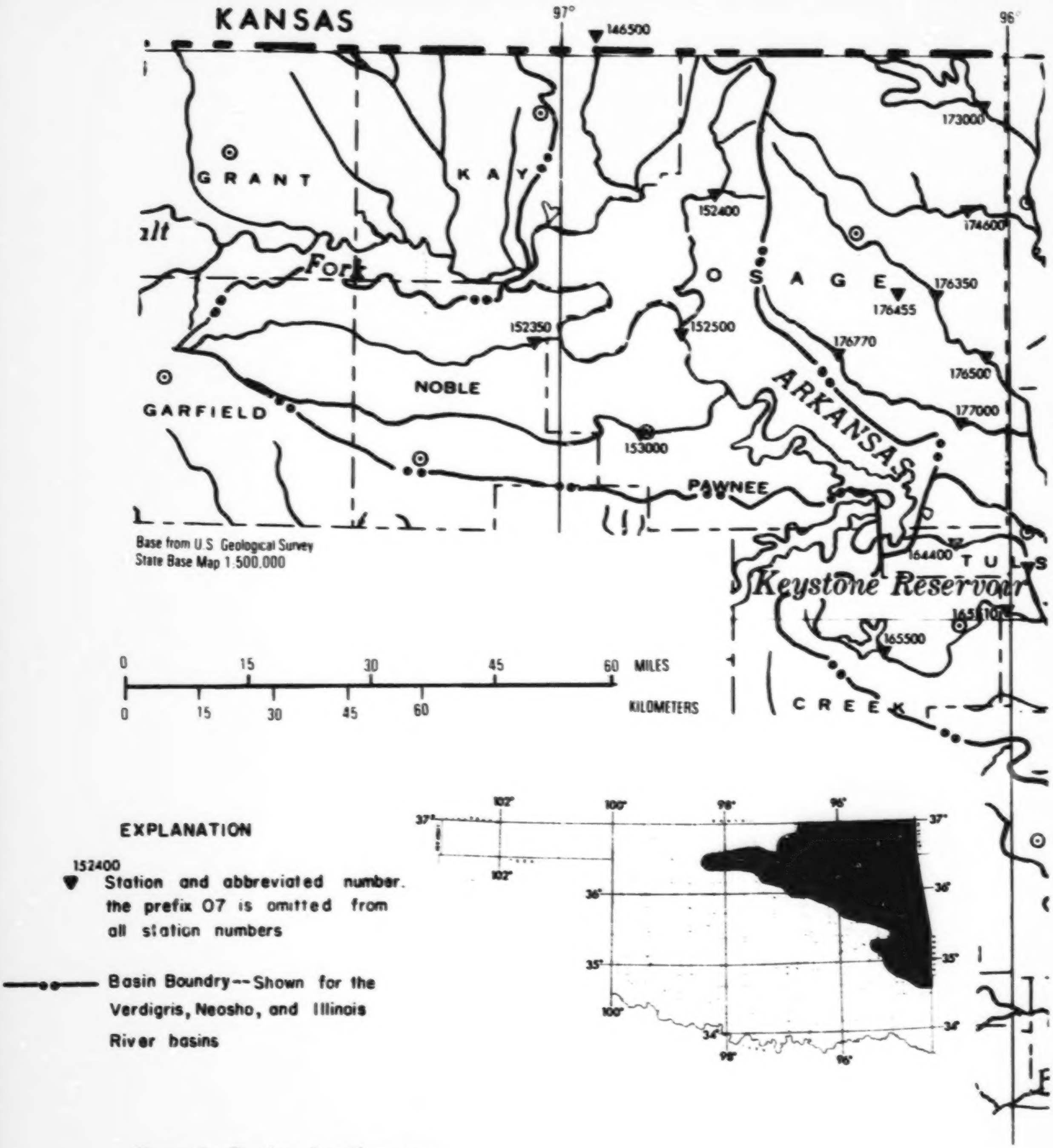
STATION ORDER

In order to reduce the physical size of the report and to make it more useable on a regional and hydrologic basis to water planners and managers, the report has been divided into five parts. The river basins included within each part are as follows:

Part 1:	Arkansas River Mainstem and Verdigris, Neosho, and Illinois River basins.
Part 2:	Salt Fork Arkansas and Cimarron River basins.
Part 3:	Canadian, North Canadian, and Deep Fork River basins.
Part 4:	Red River Mainstem and North Fork Red River basin.
Part 5:	Washita River basin.

Within each part the stations are grouped by river basin. All rivers and streams within Oklahoma are tributary to either the Arkansas River or the Red River. Mainstem stations are those stations on the Arkansas or Red River or are on streams whose basins are directly tributary to the Arkansas or Red River and are too small to be listed as a separate basin. The stations are arranged in alphabetical order within each basin or mainstem designation. Where more than one station on a stream is reported, those stations are arranged in downstream order.

The location of each station is shown in figure 1, and the stations are identified by their station numbers. All of the assigned station numbers in Oklahoma begin with the digits 07. These two digits are omitted from the station numbers shown in figure 1. For example, station number 07146500 is shown in figure 1 as 146500. A listing of the stations by number that provides cross-indexing of stations shown in figure 1 with their station summaries is provided in table 3, which follows the station summaries.


KANSAS
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OSAGE
176350
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152500
176770
176500
NOBLE
GARFIELD
ARKANSAS
177000
153000
PAWNEE
164400
TULS
Keystone Reservoir
165500
CREEK
0
15
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45
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MILES
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60
KILOMETERS
102°
100°
98°
96°
37°
36°
35°
34°

Base from U.S. Geological Survey State Base Map 1:500,000

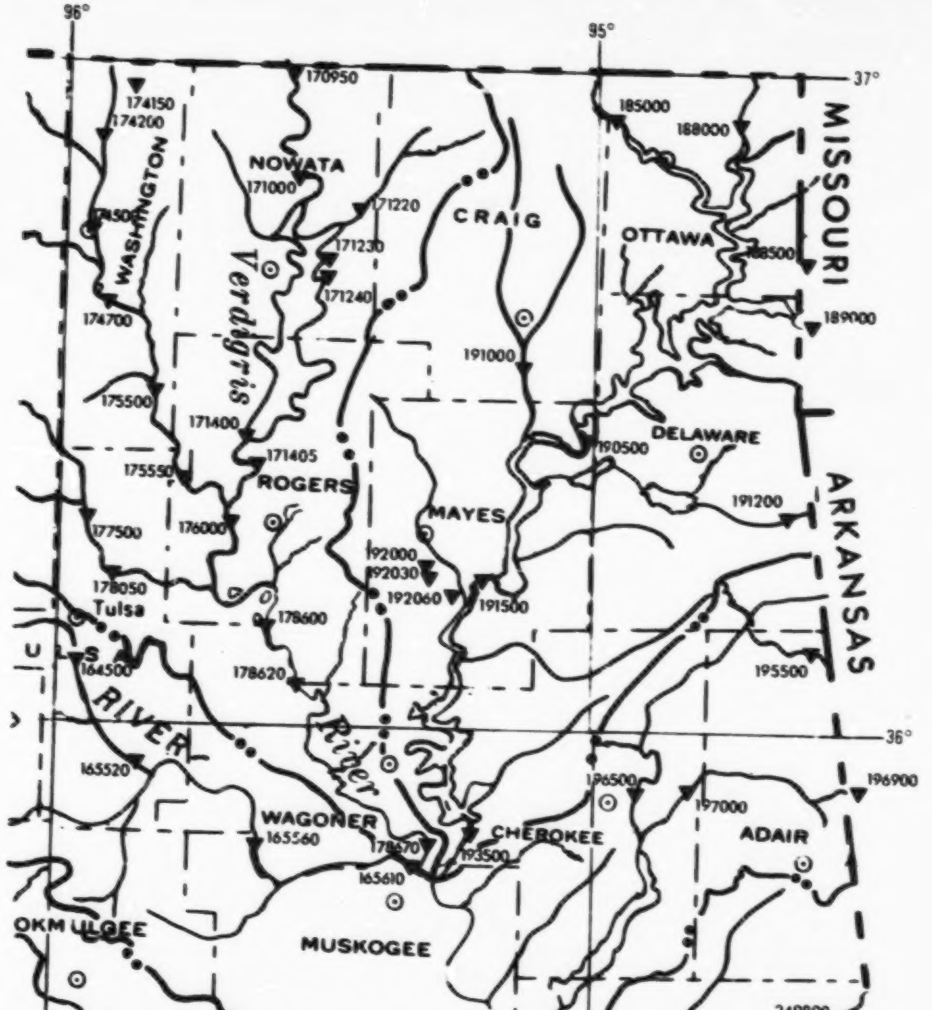
EXPLANATION

152400

▼ Station and abbreviated number. the prefix 07 is omitted from all station numbers

—•—•— Basin Boundry--Shown for the Verdigris, Neosho, and Illinois River basins

Figure 1.- Station location map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ARKANSAS
WASHINGTON
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CRAIG
OTTAWA
DELAWARE
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MAYES
Tulsa
WAGONER
CHEROKEE
ADAIR
OKMULGEE
MUSKOGEE
SEQUOYAH
MC INTOSH
HASKELL
LATIMER
LE FLORE
Verdigris
River
Eufaula Reservoir
U. S. A. RIVER
RIVER
174150
174200
170950
185000
188000
171000
171220
171230
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196900
197000
165560
178670
193500
165610
249800
194550
198000
245500
250500
246400
246600
246500
246000
249200
249410
249400
247500
248500
247000

DATA PRESENTATION

Each station summary is in the following format:

1. Station location.
2. Drainage area.
3. Period of water-quality record.
4. Pertinent remarks if any.
5. A discussion of water types.
6. Trend analysis where sufficient current data are available.
7. A discussion of water quality related to use as a public water supply.
8. A discussion of water quality related to use for irrigation.
9. Two tables; one providing the univariate statistics for the selected constituents, and one showing the frequency distribution for the constituents.
10. Plots of the specific conductance versus the major cation ratios and the major anion ratios.
11. An irrigation diagram.

The selection of water-quality constituents was based on their significance to water use for public supply and irrigation. Dissolved solids as determined by the residue on evaporation at 180° Celsius method was included because it is a measure of the total amount of dissolved material present in the water.

The data are discussed in the summaries on a per value basis rather than a percentage of time basis. For some stations the percentage of values can be thought of as the percentage of time. However, when the period of record is less than 3 years or the number of values is less than 40, care needs to be taken in assuming this relationship. The data were analyzed using the Statistical Analysis System 1976 version (SAS-76), developed by Barr and others (1976), and the Supplemental Library (Helwig, 1977).

EXPLANATION OF STATION SUMMARY

Location

The location for each station is given in at least three ways: (1) by latitude (lat) and longitude (long); (2) by the township, range, and section; and (3) by distance and direction from local geographic features such as bridges, tributary streams, and towns. The location also is described, where information is available, by river mile, the distance the station is upstream from the mouth of the stream.

Drainage Area

The drainage area of a stream at a specific location is that area, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the river upstream from the specified point. Drainage-area values given include all closed basins, or noncontributing areas, within the area unless otherwise noted.

Period of Record

The period of record in this report is the period of water-quality record by water year--that is, the 12-month period ending September 30. The water year is designated by the calendar year in which it ends and includes 9 of the 12 months. The period of record for the water-quality data used in this report includes all available WATSTORE data through the 1978 water year. A water year was included in the period of record when at least one sample was available for that water year.

Water Type

Water can be typed according to the percentage of each of the major ions in solution. For example, if the calcium and sulfate ions are predominant, the water would be described as calcium sulfate type. In this report a cation or anion was considered to be a predominant ion if it constituted at least 50 percent of its respective cation or anion group. The major cations, calcium, magnesium, sodium, and potassium, which are electropositive, and the major anions, carbonate, bicarbonate, chloride, and sulfate, which are electronegative, generally constitute more than 95 percent of the total ions in solution.

Ordinarily the concentration of the potassium ion is very small in relation to the sodium ion concentration. Potassium is grouped with the sodium because of its small concentration and because it is chemically similar to sodium; and the ions are referred to as sodium rather than sodium plus potassium.

The relationship between the carbonate and bicarbonate ions is pH dependent. Both carbonate and bicarbonate ions are considered to be present in solution when the pH is greater than 8.3, and when the pH is equal to or less than 8.3 only the bicarbonate ion is considered present. Because the relation between pH and specific conductance at each station was not determined, the carbonate and bicarbonate ions are referred to as carbonate/bicarbonate.

The concentration and relationship of the major ions in solution will, to a large extent, be determined by the geology of the terrane through which the water flowed and how the constituents in the water reacted to mixing with other waters.

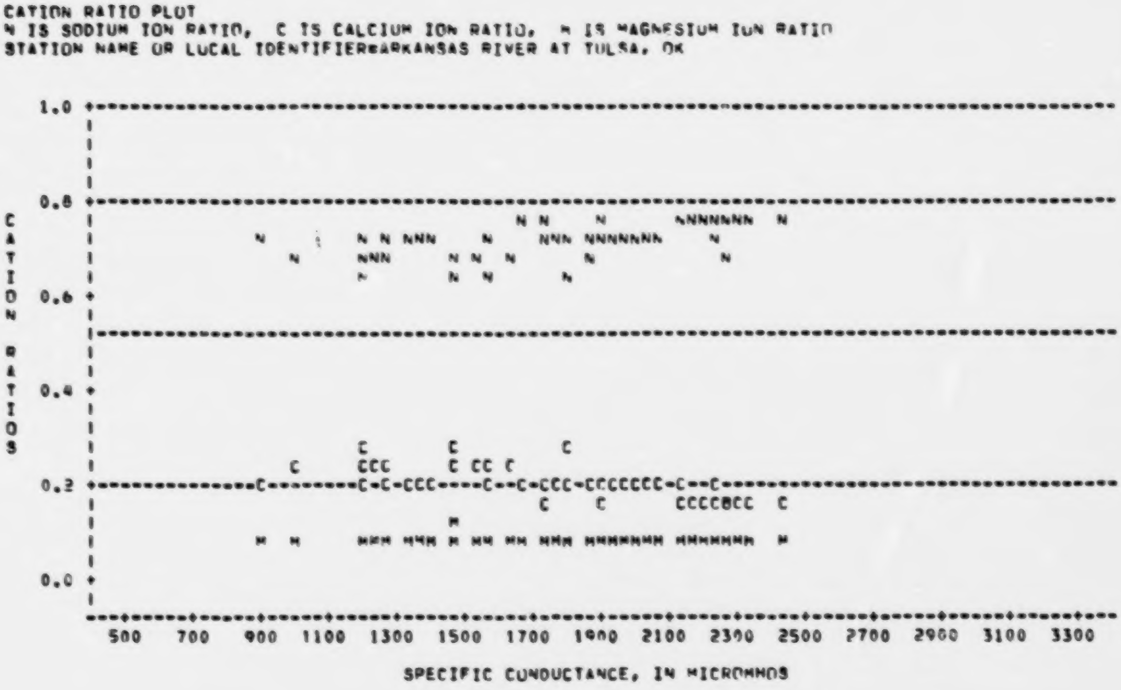
Cation and Anion Ratio Plots

The cation ratio plot presents the ratio of each major cation, expressed in meq/L (milliequivalents per liter), to the sum of the major cations, in meq/L, plotted versus the specific conductance. The anion ratio plot was prepared in the same manner using the major anions. Each ion ratio plot requires complete data for all major cations or all major anions. In many instances, an analysis with complete anion data will not have complete cation data. Some confusion in the comparison of the ion ratio plots can result from the different data requirements for the cation and anion plots. However, to provide as complete a water-quality summary as possible, all data that met the various plotting requirements were included. These plots were constructed to determine whether the ionic distributions changed with changes in the total concentration of dissolved materials. Example plots of the cation and anion ratios are shown in figures 2 and 3.

Trend

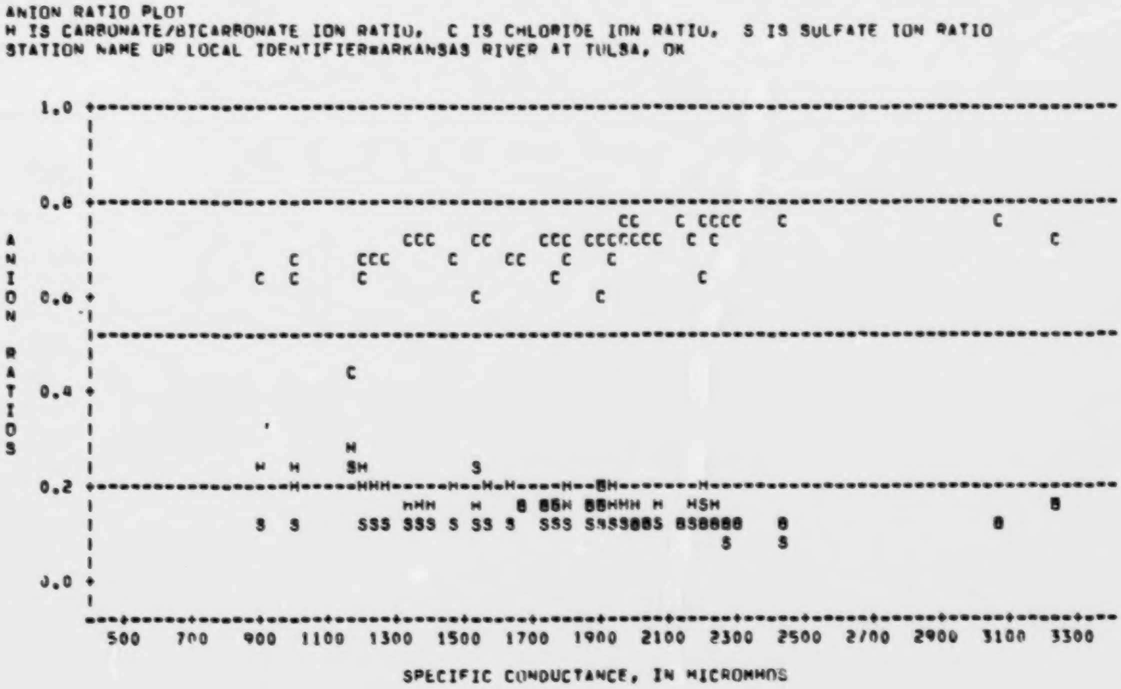
Trend analyses were made to determine whether the concentration of a constituent was increasing (positive trend) or decreasing (negative trend) with time. Only data collected after October 1, 1960, were used in the trend analyses. This was done because of the format in which SAS stores the dates and because it was believed that 18 years was a sufficient time span to adequately determine the presence of trend. Trend analysis was made only for those stations that had current data (data from 1976, 1977, or 1978 water years) because trend analyses based on historical data could be misleading. Trend analysis is significant because it indicates what is occurring in the present, and what possible effects may occur in the future.

Plots, not included in this report, of dissolved solids, hardness, sulfate, and chloride concentrations versus time were generated where current data were available. The plots were examined to determine if there were data for a minimum time span, 5 years, to make a statistical test for trend and to see if there were any indication of trend. The test chosen for trend analysis was a Spearman's rho technique and is fully described by Conover (1971). The test is two sided and indicates whether a trend, if any, is positive or negative. The test was made for the four constituents at the 95-percent probability level. The technique does not indicate the cause of a trend, only that a trend is or is not occurring. A trend may be the result of an extended period of drought or a period of much precipitation.



CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT TULSA, OK

Figure 2 - Cation ratio plot for Arkansas River at Tulsa, Oklahoma.



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT TULSA, OK

Figure 3 - Anion ratio plot for Arkansas River at Tulsa, Oklahoma.

Public Water Supply

This section includes a discussion of water hardness, constituents for which maximum concentrations have been recommended, and constituents for which maximum contaminant levels have been established by regulation. Where adequate data were available, an evaluation was made as to the suitability for use as a public supply. Suitability for use as a public supply is based on available water-quality criteria and is an evaluation of the fitness of the water for its intended use. Water evaluated as unsuitable because a water-quality constituent(s) exceeds established criteria may or may not be acceptable for use by the population to be supplied. The acceptability of water for public supply depends a great deal on the availability, or more importantly, the non-availability of a more suitable supply source. In many parts of the United States, particularly in the arid West, the public water supply is accepted by the majority of the population served even though the concentrations of such constituents as sulfate and chloride commonly exceed the recommended limits, simply because a more suitable source is not available. Because the acceptability of a water supply depends on many factors other than the water quality, no evaluation of acceptability was made. All evaluations of the suitability for use were based on the water as a raw untreated source and do not reflect any evaluation of suitability after treatment. However, these evaluations need to be used with caution because, for many stations, the data were more than 10 years old and need to be updated to determine the existing water quality. Furthermore, important data were missing for many stations, particularly the toxic metals. The suitability evaluations were provided to show whether the existing data indicated a constituent concentration which might preclude the use of the water for public supply.

Hardness

Hardness was included because, in relation to public water supply, it is one of the most noticeable water-quality characteristics. No maximum hardness concentration has been recommended because hardness is not generally considered a human health hazard. As hardness increases the efficiency of soaps and detergents decreases. When the concentration of hardness is large, deposition or scaling occurs, thereby reducing the efficiency of hot water tanks and restricting the flow of water in plumbing systems. Additional information on hardness is given by Durfor and Becker (1964), and Hem (1970). The concentration of hardness is expressed as mg/L (milligrams per liter) as $CaCO_3$ (calcium carbonate). The hardness classification used in this report and given in the following table is that used by Durfor and Becker (1964, p. 27).

Hardness range (mg/L as $CaCO_3$)	Description
0 to 60	Soft
61 to 120	Moderately hard
121 to 180	Hard
Greater than 180	Very hard

Constituents with recommended maximum concentrations

Maximum concentrations for several water-quality constituents that have not had maximum contaminant levels set by regulation have been recommended by the National Academy of Sciences and National Academy of Engineering (1973). These constituents generally are not toxic to humans at their recommended limits. Particular constituents affect such qualities as color, taste, and odor; some may cause staining of clothes and plumbing fixtures; and others produce laxative effects in humans. The selected water-quality constituents in this group are chloride, sulfate, pH, and iron. Other components such as color, odor, oil and grease, silver, and zinc, were excluded because of the lack of analytical data. Following is a brief summary of reasons for selecting each constituent:

Chloride.--Affects taste. Normal water-treatment processes do not remove chloride.

Sulfate.--Affects taste and produces laxative effects. Normal water-treatment processes do not remove sulfate.

pH.--Contributes to the corrosion of plumbing and water distribution systems. The cost of treatment for waters with pH in excess of the recommended limits may be uneconomical.

Iron.--Causes staining of plumbing fixtures and clothing, accumulation of deposits in water distribution systems, and objectional taste.

Data in the following table were taken from the National Academy of Sciences and National Academy of Engineering (1973) report.

Constituent	Recommended concentration limit(s)
Chloride	250 mg/L
Sulfate	250 mg/L
pH	5.0 and 9.0 units
Iron	300 ug/L

Constituents with maximum contaminant levels

The U.S. Environmental Protection Agency through the Safe Drinking Water Act (Public Law 93-523) announced regulations for maximum contaminant levels in public water supplies for certain constituents (U.S. Environmental Protection Agency, 1976). The constituents, fluoride, arsenic, cadmium, chromium, lead, and mercury are included in this report; however, barium, selenium, and silver were not selected because of the almost total lack of historic data. Nitrate-nitrogen was not selected because changes in analytical methods and onsite field preservation techniques have produced data that probably are not comparable.

The maximum contaminant level for fluoride is based on the annual average maximum daily air temperature at the water source and is tabulated below. The maximum contaminant levels for fluoride given in the following table are from the U.S. Environmental Protection Agency (1976).

Temperature (°F)	Maximum contaminant level (mg/L)
53.7 and below	2.4
53.8 to 58.3	2.2
58.4 to 63.8	2.0
63.9 to 70.6	1.8
70.7 to 79.2	1.6
79.3 to 90.5	1.4

Although the amount of data available at most stations was limited, the toxic metals were included because of their significance to human health. The following table lists the maximum contaminant levels established by regulation for the toxic metals, U.S. Environmental Protection Agency (1976).

Constituent	Maximum contaminant level (ug/L)
Arsenic	50
Cadmium	10
Chromium	50
Lead	50
Mercury	2.0

Irrigation

The irrigation section of each station summary is based primarily on the irrigation waters classification system developed by Wilcox (1955). This system describes the utility of waters for irrigation based on their respective salinity and sodium hazards. Where boron data were available an evaluation was made on the possible phytotoxic effects of this trace element, based in the information contained in the National Academy of Sciences and National Academy of Engineering report (1973).

Salinity and sodium hazard classification

The Wilcox classification system depicts a salinity hazard based on the specific conductance, and a sodium hazard based on the SAR (sodium adsorption ratio). The SAR is based on the ratio of sodium to calcium and magnesium and expresses the relative activity of sodium ion in exchange reactions with soil. Complete discussions of the SAR and the method for its computation are provided in Hem (1970) and Wilcox (1955).

The following descriptions of the effects of the different salinity and sodium hazard classes are taken directly from Wilcox (1955).

"Low-salinity water (C1) can be used for irrigation with most crops on most soils, with little likelihood that a salinity problem will develop. Some leaching is required, but this occurs under normal irrigation practices except in soils of extremely low permeability.

Medium-salinity water (C2) can be used if a moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown in most instances with special practices for salinity control.

High-salinity water (C3) cannot be used on soils with restricted drainage. Even with adequate drainage, special management for salinity control may be required and plants with good salt tolerance should be selected.

Very high salinity water (C4) is not suitable for irrigation under ordinary conditions but may be used occasionally under very special circumstances. The soils must be permeable, drainage must be adequate, irrigation water must be applied in excess to provide considerable leaching, and very salt-tolerant crops should be selected."

"Low sodium water (S1) can be used for irrigation on almost all soils with little danger of the development of harmful levels of exchangeable sodium. However, sodium-sensitive crops, such as stone-fruit trees and avocados, may accumulate injurious concentrations of sodium.

Medium-sodium water (S2) will present an appreciable sodium hazard in fine textured soils of high cation-exchange capacity, especially under low-leaching conditions, unless gypsum is present in the soil. This water may be used on coarse textured or organic soils that have good permeability.

High-sodium water (S3) may produce harmful levels of exchangeable sodium in most soils and will require special soil management--good drainage, high leaching, and additions of organic matter. Gypsiferous soils may not develop harmful levels of exchangeable sodium from such waters.

Very high sodium water (S4) is generally unsatisfactory for irrigation purposes except at low and perhaps medium salinity where the solution of calcium from the soil or the use of gypsum or other amendments may make the use of this water feasible."

Additional information on the effect of salinity and sodium on water use for irrigation is given by Wilcox (1955) and the National Academy of Sciences and National Academy of Engineering (1973).

Irrigation diagram

An irrigation diagram is included for each station where sufficient data were available. On the diagram the SAR of a sample is plotted against its specific conductance and the appropriate salinity and sodium hazards are determined (example, fig. 4). In the irrigation diagram the salinity hazard is along the horizontal axis and ranges from C1 to C4. All specific conductance values given in this report are in micromhos per centimeter at 25 degrees Celsius and are hereafter abbreviated as μmho. The specific-conductance ranges for the salinity hazard classes are: less than 250 μmho, low salinity hazard; 250 to 750 μmho, medium salinity hazard; 751 to 2,250 μmho, high salinity hazard; and greater than 2,250 μmho, very high salinity hazard. The sodium hazard is along the vertical axis and the class breakpoints S1 through S4 vary with the specific conductance and are delineated by the sloping lines.

Boron

Boron has long been recognized as a phytotoxic trace element. The recommended maximum boron concentrations for use on all soils from the National Academy of Sciences and National Academy of Engineering (1973) report are: boron sensitive plants, 750 μg/L (micrograms per liter); boron semitolerant plants, 1,000 μg/L; and boron tolerant plants, 2,000 μg/L. The relative boron tolerances of certain plants are shown in table 1. This table was taken directly from the Wilcox (1955) report and lists many plants that are not native to or commercially grown in Oklahoma; however, it is possible that most or all of these plants may be grown in Oklahoma on a non-commercial basis.

IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD, C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=BIRD CREEK NR BARNSDALL, OK

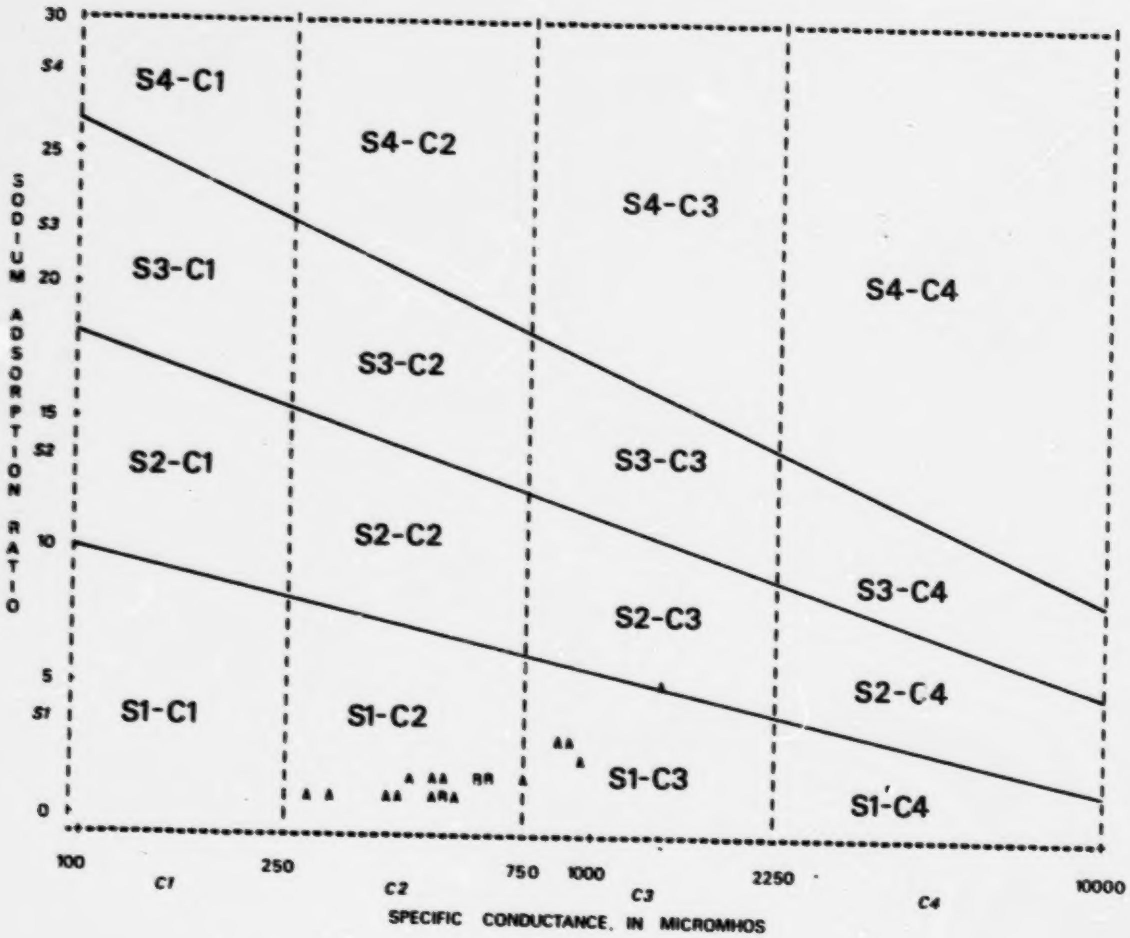


Figure 4.- Irrigation diagram for Bird Creek near Barnsdall, Oklahoma.

Table 1.--Relative boron tolerance of certain plants

[From Wilcox (1955). In each group, the plants first named are considered as more tolerant; the last named, more sensitive]

Tolerant	Semitolerant	Sensitive
Athel (*Tamerix aphylla*)	Sunflower (native)	Pecan
Asparagus	Potato	Walnut (Black; and Persian or English)
Palm (*Phoenix canariensis*)	Cotton (Acala and Pima)	Jerusalem artichoke
Date Palm (*P. dactylifera*)	Tomato	Navy bean
Sugar beet	Sweet pea	American Elm
Mangel	Radish	Plum
Garden beet	Field pea	Pear
Alfalfa	Ragged robin rose	Apple
Gladiolus	Olive	Grape (Sultaninia and Malaga)
Broad bean	Barley	Kadota fig
Onion	Wheat	Persimmon
Turnip	Corn	Cherry
Cabbage	Milo	Peach
Lettuce	Oat	Apricot
Carrot	Zinnia	Thornless blackberry
	Pumpkin	Orange
	Bell pepper	Avocado
	Sweet potato	Grapefruit
	Lima bean	Lemon

Univariate Statistics

The station summaries show the univariate statistics for each constituent. The units of concentration in the summary are those units that have already been described for the constituents. The standard deviation, skewness, and kurtosis were not computed for constituents with less than 10 values. When only one value was available for a constituent, that value is listed in the mean column. In many instances the number of values for one constituent are two to three or more times greater than the number of values for another constituent. Therefore, comparison of statistics, particularly minimums and maximums, between constituents needs to be done with care.

The following are brief descriptions of the headings in the univariate statistics summary for each station.

N.--The number of values available for the period of record for that constituent.
MEAN.--The arithmetic average, except for pH which is the median or middle value.
MIN.--The minimum value recorded.
MAX.--The maximum value recorded.
STD.--The standard deviation of the constituent distribution.

SKEW.--The skewness of the constituent distribution. Skewness is a measure of the asymmetry of the distribution of the data when compared to the symmetrical normal distribution. Detailed information on the theory, use, and computational methods for the skewness and kurtosis (described in the next section) are given by Fisher (1973) and Snedecor (1956). A positive value for the skewness statistic indicates there are more values smaller than the mean than values greater than the mean, and for negative skewness values the converse is true (fig. 5). Although the statistic computed for the skewness cannot be used to determine the shape of the distribution, the skewness statistic can indicate whether the distribution curve is significantly different from a normal distribution. If the sample distribution is significantly different, tests that are based on normality are not applicable. The 95-percent probability range, plus and minus, for skewness for various sample sizes is shown in table 2. As an example: For a sample size of 100, if the skewness statistic greatly exceeded plus or minus 0.47 the distribution is not considered normal at the 95-percent probability level.

KURT.--The kurtosis of the sample distribution. Kurtosis is a measure of the deviation of the sample distribution from the normal distribution. In general, kurtosis measures the relative peakness or flatness of the sample distribution curve with respect to the normal distribution. A positive kurtosis indicates peakness and a negative kurtosis indicates flatness (fig. 6). Values for the 95-percent probability limits for kurtosis for selected sample sizes are given in table 2.

Table 2.--Ninety-five percent probability limits for skewness and kurtosis for selected sample sizes

Sample size	95 percent of probability limits (plus or minus)	
	Skewness	Kurtosis
10	1.35	2.61
25	.91	1.77
50	.66	1.30
75	.54	1.07
100	.47	.94
150	.39	.77
200	.34	.67
300	.28	.55
400	.24	.48
500	.21	.43
600	.20	.39
700	.18	.36

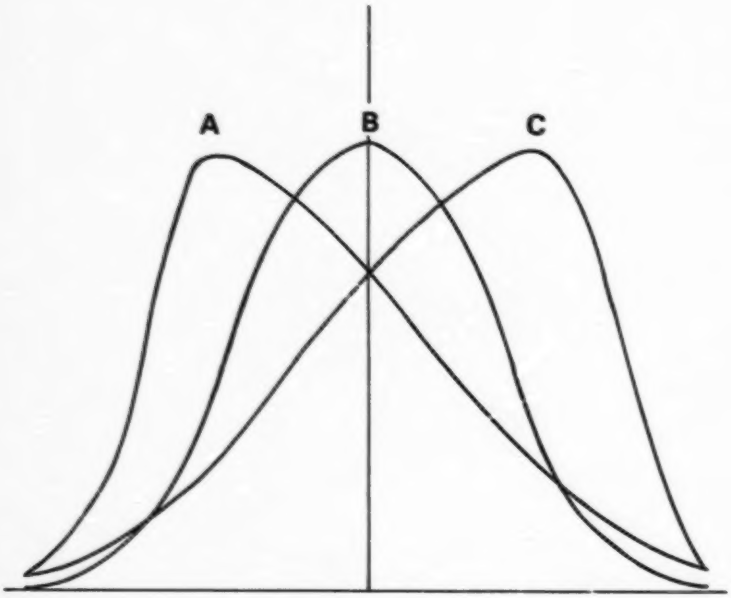


Figure 5 Skewness and the normal distribution. Curve A is positive skewness, curve B is normal distribution, and curve C is negative skewness.

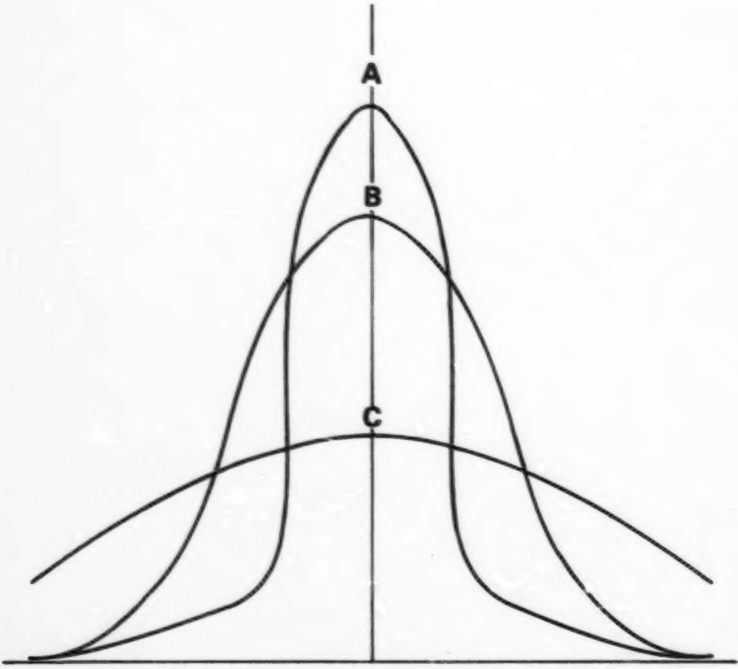


Figure 6 Kurtosis and the normal distribution. Curve A is positive kurtosis, curve B is normal distribution, and curve C is negative kurtosis.

Frequency Distribution

The frequency distribution table shows selected percentile concentrations from the cumulative frequency distributions of constituents for which 10 or more values were available. The concentration units in the table are the same as previously described for the constituents. The percentile concentrations in the table are explained in the following example: The concentration shown in the 25th percentile column is that concentration for which 25 percent of the samples had concentrations less than or equal to the column value.

STATION NUMBERING SYSTEM

Stations numbers are assigned in a downstream sequence so that as one progresses downstream the numbers become larger. Station numbers on a tributary are assigned on a rank-order basis. Station numbers on a first-rank tributary are assigned so that the numbers are larger than any number assigned to an upstream station on the mainstem and are smaller than any station number assigned to a station downstream on the mainstem. The station numbers on the tributary are assigned in the same downstream method as on the mainstem. A first-rank tributary is one that flows directly into the mainstem, a second-rank tributary is one which flows into a first-rank tributary, and so on for the greater ranked tributaries. The numbering system is followed from the mainstem up through the greater ranked tributaries, first rank, second rank, third rank, and so on.

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STATION SUMMARIES

All constituent values except for pH and specific conductance are for the dissolved phase. Specific conductance and pH are measured on unfiltered samples. The values for the standard deviation, skewness, and kurtosis for pH represent the distribution of the pH values and not the distribution of the hydrogen ion concentrations and were computed from the arithmetic mean of the pH values.

The units of concentration for selected constituents in the following station summaries are as follows:

Milligrams per liter (mg/L) - Dissolved solids, total hardness, chloride, sulfate, and fluoride.
Micrograms per liter (μg/L) - Iron, arsenic, cadmium, chromium, lead, mercury, and boron.
Micromhos per centimeter at 25 degrees Celsius (μmho) - Specific conductance.
Standard units - pH.
Unitless - SAR.

ARKANSAS RIVER MAINSTEM

07146500 - Arkansas River at Arkansas City, Kans.

LOCATION.--Lat 37°03'23", long 97°03'32", in NE¼NE¼NE¼ sec.35, T.34 S., R.3 E., Cowley County, at bridge on Chestnut Street, 0.4 mi upstream from St. Louis-San Francisco Railway Co. bridge, 0.5 mi upstream from gage on U.S. Highway 166 bridge, 0.5 mi west of Arkansas City, 5.9 mi upstream from Walnut River, and at mile 701.9.

DRAINAGE AREA.--43,713 mi^2, of which 7,607 mi^2 is probably noncontributing.

PERIOD OF RECORD.--1952 to 1978.

REMARKS.--Water-quality samples were collected from 1952 to 1973 by the Oklahoma District, U.S. Geological Survey and were collected after 1973, by the Kansas District, U.S. Geological Survey.

WATER TYPE.--The Arkansas River at this location was sodium chloride type. The ion ratio plots show that as specific conductance increases the sodium ion and the chloride ion ratios increase. For specific conductance greater than 3,000 mhos, the sodium and chloride ion ratios become relatively constant at about 75 percent. As specific conductance increases, the carbonate/bicarbonate and calcium ion ratios decrease. For specific conductance greater than 3,000 µmhos, the ratios also become relatively constant, at about 16 to 18 percent. Throughout the range of specific conductance measured at this location, the magnesium and the sulfate ratios remained relatively constant.

TREND.--Plots of dissolved solids, hardness, chloride, and sulfate concentrations versus time did not clearly indicate any trend. However, the Spearman's rhos for dissolved solids, chloride, and sulfate versus time show that at the 95-percent probability level there has been a trend of increasing concentration since 1960. The indicated trend is slight and may be the result of relatively little precipitation during the past few years. No trend was indicated for hardness at the 95-percent probability level.

PUBLIC WATER SUPPLY.--The average hardness was 303 mg/L and the water was very hard. The recommended maximum pH of 9.0 was exceeded by 3 percent of the pH values, the recommended maximum chloride concentration of 250 mg/L was exceeded by 66 percent of the chloride values, and the recommended maximum sulfate concentration of 250 mg/L was exceeded by 14 percent of the sulfate values. The maximum contaminant levels for the toxic metals cadmium, chromium, and lead were exceeded in one sample. The maximum concentration recorded for that sample for each of these constituents was 100 ug/L. In 95 percent of the samples analyzed for these constituents, concentrations were less than 20 ug/L. Because of the frequency of exceedence of recommended maximum concentrations by chloride and sulfate, this water is probably not suitable for use as a public supply.

IRRIGATION.--The salinity hazard at this station ranged from medium to very high, with the salinity hazard being high in most of the samples. The specific conductance, salinity hazard, was greater than 750 umhos in 87 percent of the samples. At this station, the sodium hazard also increased when the salinity hazard increased. The sodium hazard was low to medium for most of the SAR values and was high to very high for about 10 percent of the SAR values. Boron concentrations were large enough at times that some of the more boron sensitive plants could be adversly affected. Boron semi-tolerant and tolerant plants should not be affected.

07146500 - Arkansas River at Arkansas City, Kans.--Continued

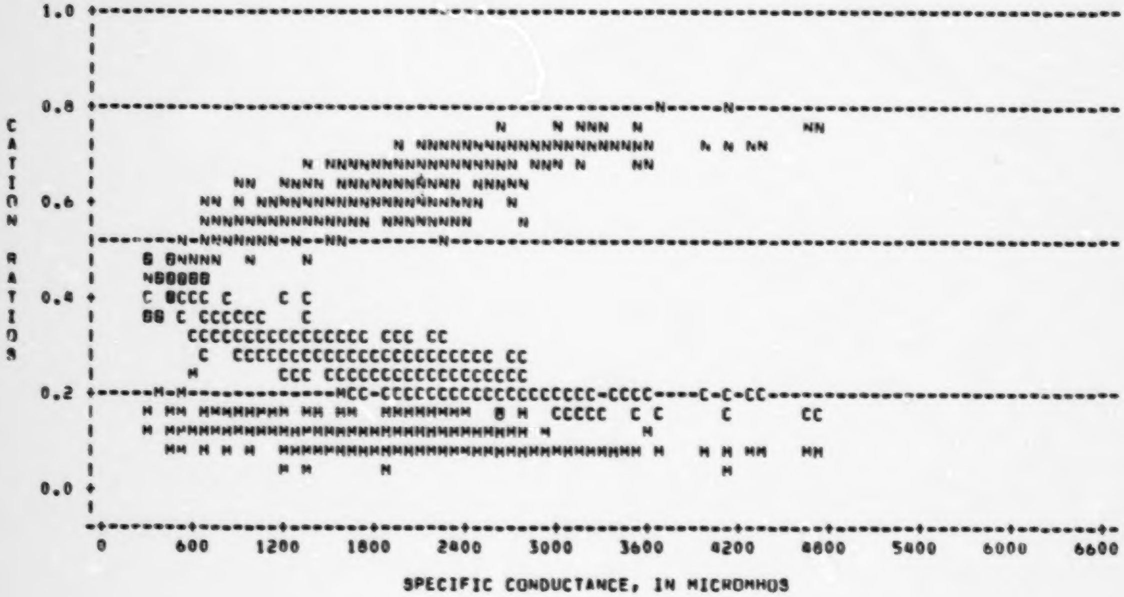
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	1639	1706	229	6540	754	0.42	1.38
Dissolved solids	1573	1015	132	4090	449	.40	1.47
pH	1495	8.1	6.6	10.0	0.4	.15	0.90
Total hardness	1505	303	24	760	110	.02	-.42
Chloride	1714	347	20	1850	195	1.03	3.73
Sulfate	1576	166	15	630	86	.92	1.86
Iron	104	13	0	110	26	2.22	4.39
Fluoride	223	0.4	0.0	1.1	0.2	.22	1.81
Arsenic	20	4	1	7	2.0	.28	.15
Cadmium	20	7	0	100	22	4.46	19.90
Chromium	21	6	0	100	22	4.39	19.70
Lead	20	10	0	100	22	4.10	17.62
Mercury	20	0.1	0.0	0.4	0.1	1.46	1.41
SAR	1212	6.1	1.0	21	2.4	.43	1.32
Boron	119	221	0	900	154	1.15	2.67

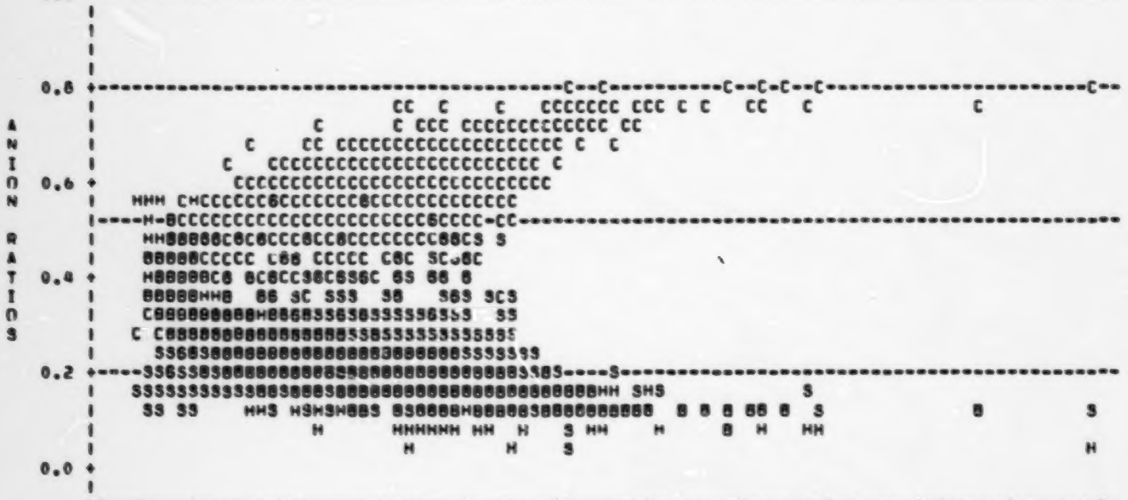
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	680	1150	1720	2230	2570
Dissolved solids	402	674	1030	1340	1510
pH	7.6	7.9	8.1	8.4	8.5
Total hardness	149	218	310	380	440
Chloride	100	198	340	470	570
Sulfate	61	105	160	211	280
Iron	0	0	0	10	50
Fluoride	0.3	0.3	0.4	0.5	0.6
Arsenic	1	2	3	4	5
Cadmium	0	0	2	2	3
Chromium	0	0	0	2	8
Lead	0	2	4	8	15
Mercury	0.0	0.0	0.0	0.1	0.2
SAR	2.8	4.4	6.1	7.7	8.9
Boron	43	108	202	298	421

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS R AT ARKANSAS CITY, KS



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS R AT ARKANSAS CITY, KS



BEST DOCUMENT AVAILABLE

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IRRIGATION DIAGRAM
C1 AND S1 ARF LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS R AT ARKANSAS CITY, KS
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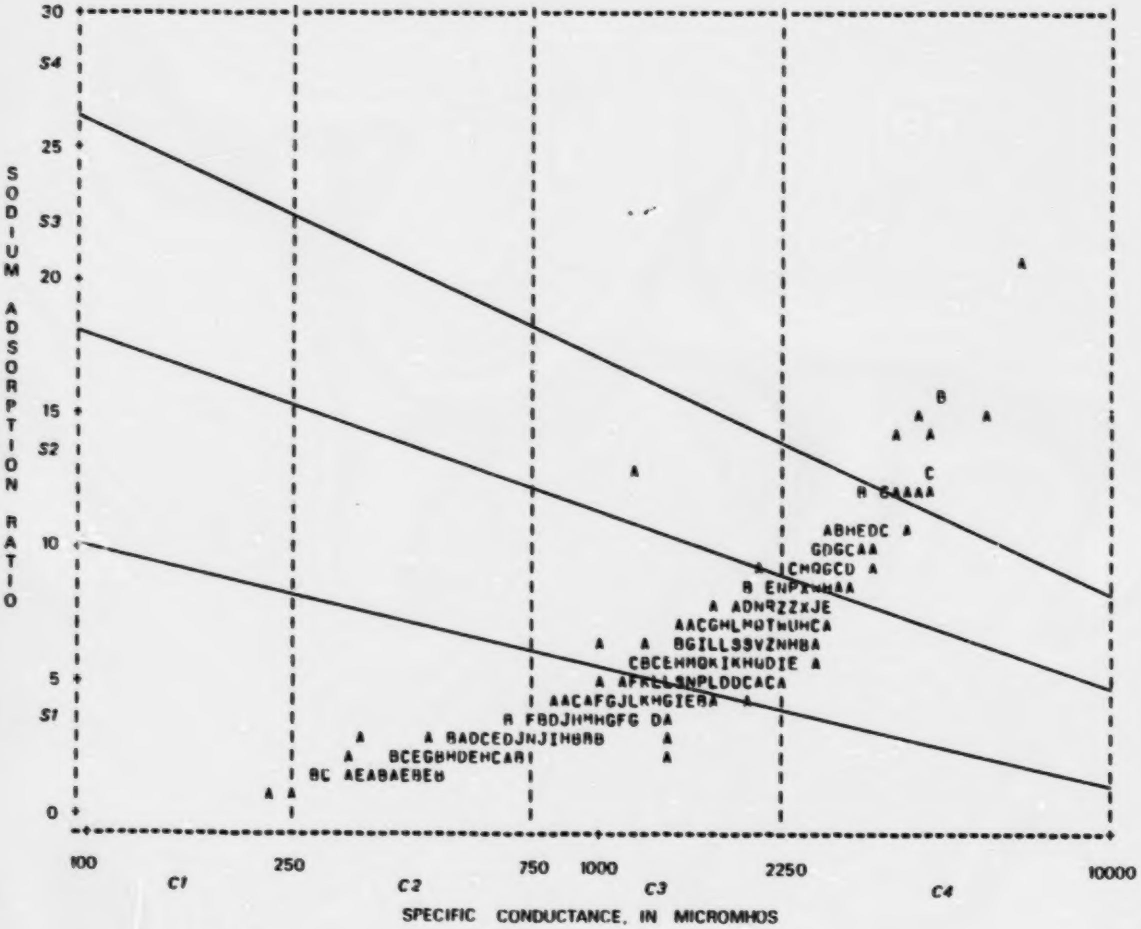


ARKANSAS RIVER MAINSTEM

07152500 - Arkansas River at Ralston, Okla.

LOCATION.--Lat 36°30'09", long 96°43'22", in NW¼ sec.1, T.23 N., R.5 E., Osage County, at bridge on State Highway 18 at Ralston, 2.0 mi downstream from Salt Creek, 2.0 mi upstream from Grayhorse Creek, and at mile 594.0.

DRAINAGE AREA.--54,465 mi^2, of which 7,615 mi^2 is probably noncontributing.

PERIOD OF RECORD.--1950 to 1963, 1965 to 1978.

WATER TYPE.--The water at this location was predominantly sodium chloride type. When the specific conductance was greater than 1,000 umhos, which occurred in 87 percent of the samples, the sodium ion and the chloride ion ratios were each 50 percent or greater. Each of these ion ratios approached a constant level of about 80 percent when the specific conductance was greater than 3,000 umhos. When specific conductances were 1,000 umhos or less, the calcium ion and carbonate/bicarbonate ion ratios were approximately equal to the sodium ion and chloride ion ratios; each ion ratio being approximately 40 percent. For specific conductances greater than 1,000 umhos, the water was sodium chloride type, and for specific conductances 1,000 umhos or less, the water was mixed type.

TREND.--Spearman's rhos for dissolved solids, hardness, chloride, and sulfate at the 95-percent probability level indicate that there were no trends. The plots of dissolved solids, hardness, sulfate and chloride versus time also indicate no trend.

PUBLIC WATER SUPPLY.--The average hardness of the water was 292 mg/L and was very hard. The hardness was 180 mg/L or greater in 87 percent of the samples. In only 3 percent of the samples the hardness was less than 120 mg/L, moderately hard, and none of the samples had a hardness in the soft class, 60 mg/L or less. The recommended pH maximum of 9.0 was exceeded by less than 1 percent of the pH values; the recommended maximum chloride concentration of 250 mg/L was exceeded by 65 percent of the chloride values; and the recommended maximum sulfate concentration of 250 mg/L was exceeded by 7 percent of the sulfate values. Only 5 analyses were available for arsenic, cadmium, chromium, lead, and mercury, and none of the respective maximum contaminant levels for these metals were exceeded. Because of the frequency of exceedence of the recommended maximum concentration by chloride, this water may not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from medium to very high. The salinity hazard was high or very high, specific conductance 750 umhos or greater, in 87 percent of the samples. The sodium hazard ranged from low to very high, with approximately 20 percent of the SAR values having a high or very high salinity hazard. The data indicate that plants should not suffer any adverse affects from boron phytotoxicity.

07152500 - Arkansas River at Ralston, Okla.--Continued

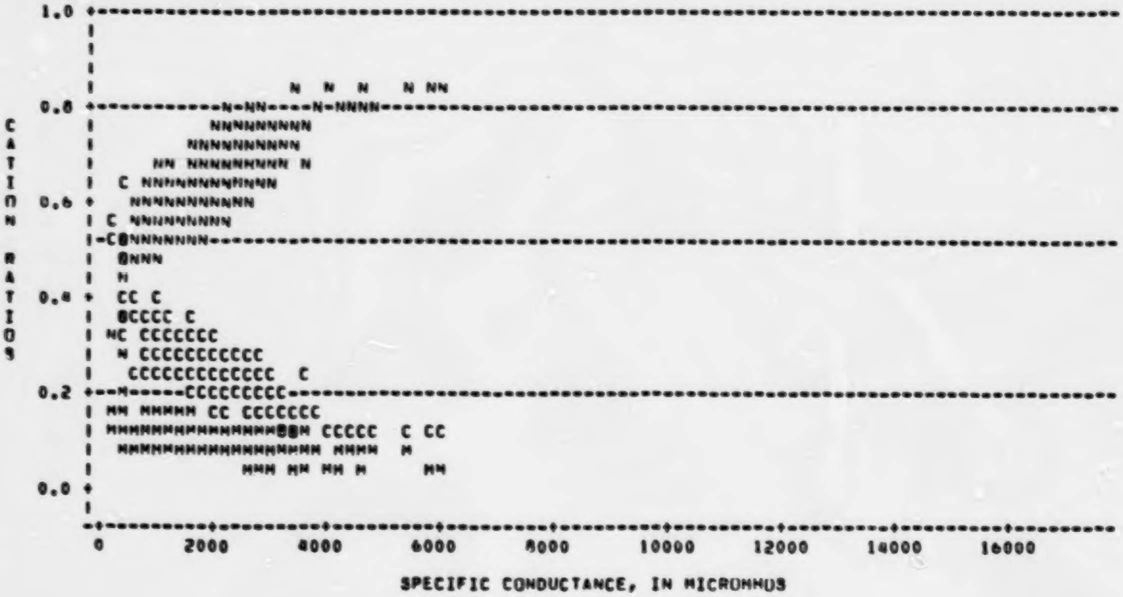
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	1825	1699	217	6060	841	0.80	1.37
Dissolved solids	1787	1038	133	9150	578	2.83	27.54
pH	1629	8.1	6.0	9.9	0.4	-.45	1.33
Total hardness	1644	292	73	582	104	.07	-.77
Chloride	1712	370	15	1700	237	1.31	3.12
Sulfate	1710	138	6.2	465	73	.70	.58
Iron	5	12	0	20			
Fluoride	228	0.4	0.1	0.9	0.2	.58	.78
Arsenic	5	2	2	3			
Cadmium	5	2	0	5			
Chromium	5	0	0	0			
Lead	5	16	1	28			
Mercury	5	0.0	0.0	0.1			
SAR	1125	6.5	0.5	25	3.3	1.22	3.22
Boron	154	184	0	690	123	1.03	1.59

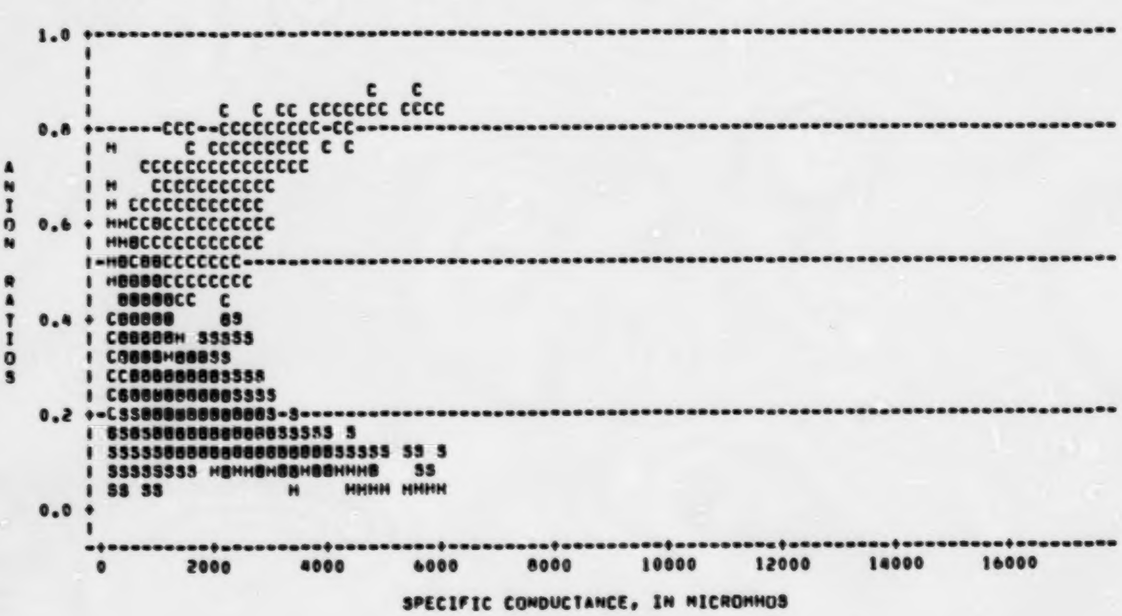
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	664	1050	1620	2220	2760
Dissolved solids	390	626	982	1350	1640
pH	7.6	7.9	8.1	8.3	8.5
Total hardness	150	208	290	370	425
Chloride	104	195	330	500	680
Sulfate	48	81	130	183	234
Iron					
Fluoride	0.2	0.3	0.4	0.5	0.5
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	2.6	4.2	6.1	8.3	10
Boron	50	97	163	250	328

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT RALSTON, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT RALSTON, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,    C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,   C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,   B = 2 OBS,   C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT RALSTON, OK
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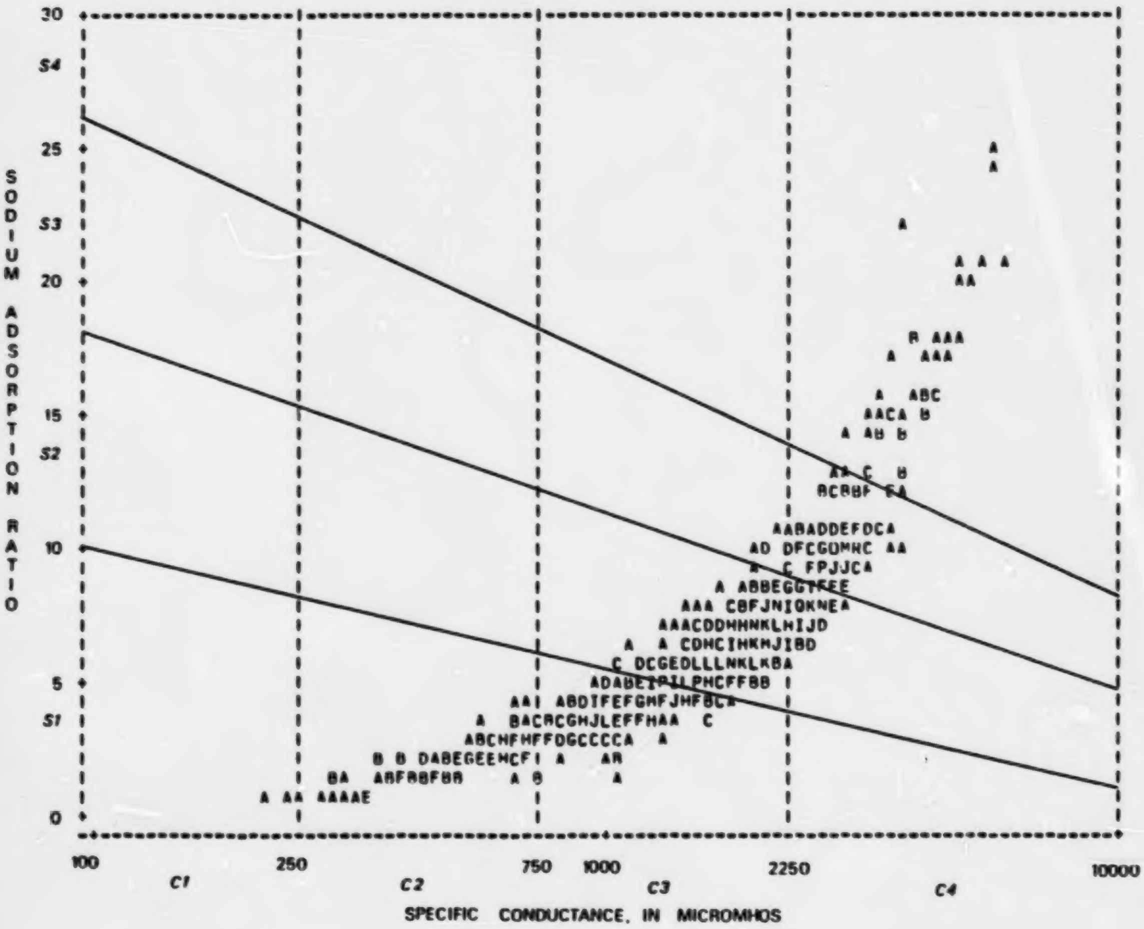


07164400 - Arkansas River at Sand Springs Bridge, near Tulsa, Okla.

LOCATION.--Lat 36°06'48", long 96°06'49", in SW¼NW¼ sec.14, T.19 N., R.11 E., Tulsa County, at bridge on State Highway 97 in Sand Springs, 5.1 mi downstream from Keystone Dam, and 10.0 mi upstream from gaging station at Tulsa.

DRAINAGE AREA.--74,615 mi^2 upstream from gaging station, of which 12,541 mi^2 is probably noncontributing.

PERIOD OF RECORD.--1947 to 1977.

WATER TYPE.--The water at this station was sodium chloride type. The chloride ion and the sodium ion ratios were generally in excess of 60 percent. For specific conductances greater than about 4,000 umhos, the sodium ion and chloride ion ratios were greater than 75 percent. Throughout the range of specific conductances measured, with few exceptions, the chloride ion and sodium ion ratios were equal to or greater than 50 percent. For specific conductances of less than 1,000 umhos, which occurred in less than 6 percent of the samples, the chloride ion ratio was at times less than 50 percent.

TREND.--Spearman's rhos for dissolved solids, chloride and sulfate versus time show that at the 95-percent probability level a trend of decreasing concentration. This trend may be the result of construction of Keystone Dam and Reservoir 5.1 mi upstream. The Spearman's rho test for hardness versus time at the 95-percent probability level indicated no trend.

PUBLIC WATER SUPPLY.--The average hardness of the water was 379 mg/L and the water was very hard. Only 8 percent of the samples had a hardness less than 180 mg/L, and none of the samples were in the soft class, less than 60 mg/L. The recommended maximum of 9.0 for pH was exceeded by less than 1 percent of the pH values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 91 percent of the chloride values and the recommended maximum sulfate concentration of 250 mg/L was exceeded by 13 percent of the sulfate values. Out of 10 analyses for mercury, one value exceeded the maximum contaminant level of 2 ug/L with a concentration of 8.2 ug/L. Because of the frequency of exceedence of the recommended maximum concentration by chloride and the indication that mercury will exceed its maximum contaminant level, this water is probably not suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from medium to very high, with 98 percent of the samples in the high or very high classes. More than half of the samples had salinity hazards in the very high class. The sodium hazard ranged from low to very high, with about 65 percent of the SAR values in the high or very high classes. Out of 114 samples analyzed for boron, one had a concentration greater than 750 ug/L, the threshold level for boron sensitive plants. Generally, boron concentrations are such that no phytotoxicity affects should occur.

07164400 - Arkansas River at Sand Springs Bridge near Tulsa, Okla.--Continued

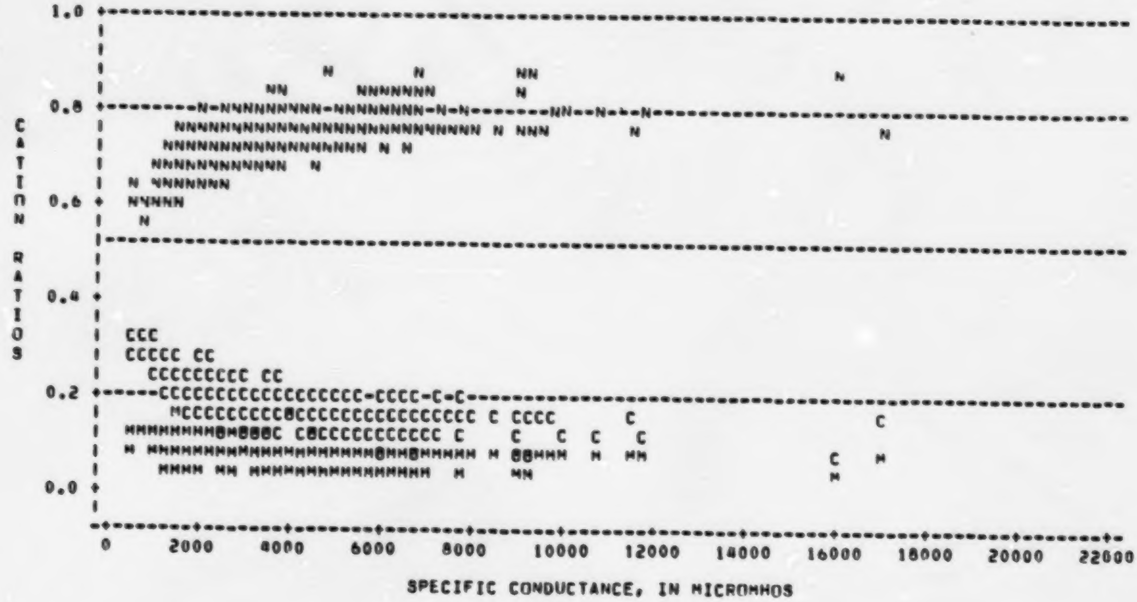
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	2165	3045	246	21200	1848	2.04	9.67
Dissolved solids	2068	1795	152	13500	1111	2.18	11.71
pH	1759	8.1	6.5	9.4	0.3	-.30	1.51
Total hardness	2008	379	62	2600	186	2.18	14.62
Chloride	2070	831	32	7450	605	2.50	14.25
Sulfate	2072	162	10	528	74	0.60	0.18
Iron	11	51	0	190	56	1.78	3.15
Fluoride	127	0.3	0.0	0.6	0.1	-.10	.39
Arsenic	11	2	1	4	1.0	.74	-.35
Cadmium	10	1	0	2	0.7	.00	.08
Chromium	10	3	0	20	7.3	2.25	4.71
Lead	10	4	0	14	3.8	1.40	2.39
Mercury	10	0.9	0.0	8.2	2.6	3.15	9.96
SAR	1384	12	1.3	50	5.3	.99	2.58
Boron	114	211	0	820	138	1.47	3.61

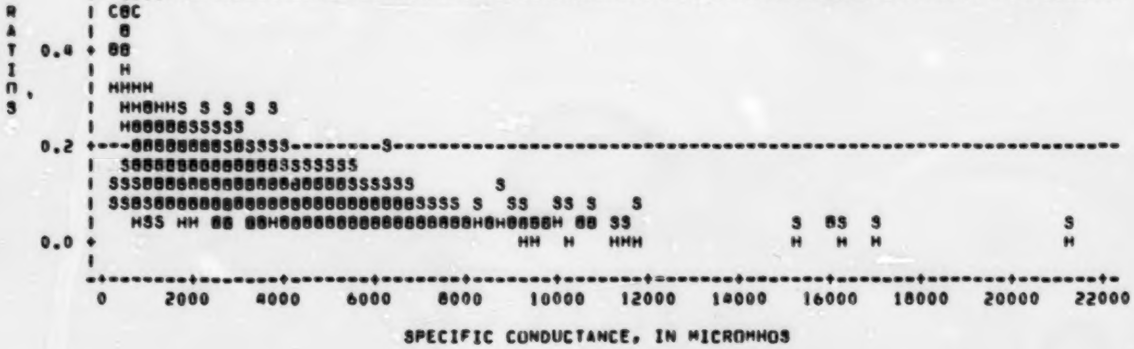
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	1230	1720	2640	3910	5390
Dissolved solids	705	1010	1540	2360	3240
pH	7.7	7.9	8.1	8.3	8.4
Total hardness	109	249	339	480	614
Chloride	270	405	690	1100	1610
Sulfate	75	103	155	210	266
Iron	1	10	28	50	110
Fluoride	0.2	0.3	0.3	0.4	0.5
Arsenic	1	1	2	2	3
Cadmium	0	0	1	1	1
Chromium	0	0	0	1	10
Lead	0	0	1	5	7
Mercury	0.0	0.0	0.0	0.1	0.3
SAR	5.5	7.5	11	14	18
Boron	72	122	180	275	376

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT SAND SPRINGS NR TULSA, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT SAND SPRINGS NR TULSA, OK



BEST DOCUMENT AVAILABLE

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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT SAND SPRINGS NR TULSA, OK
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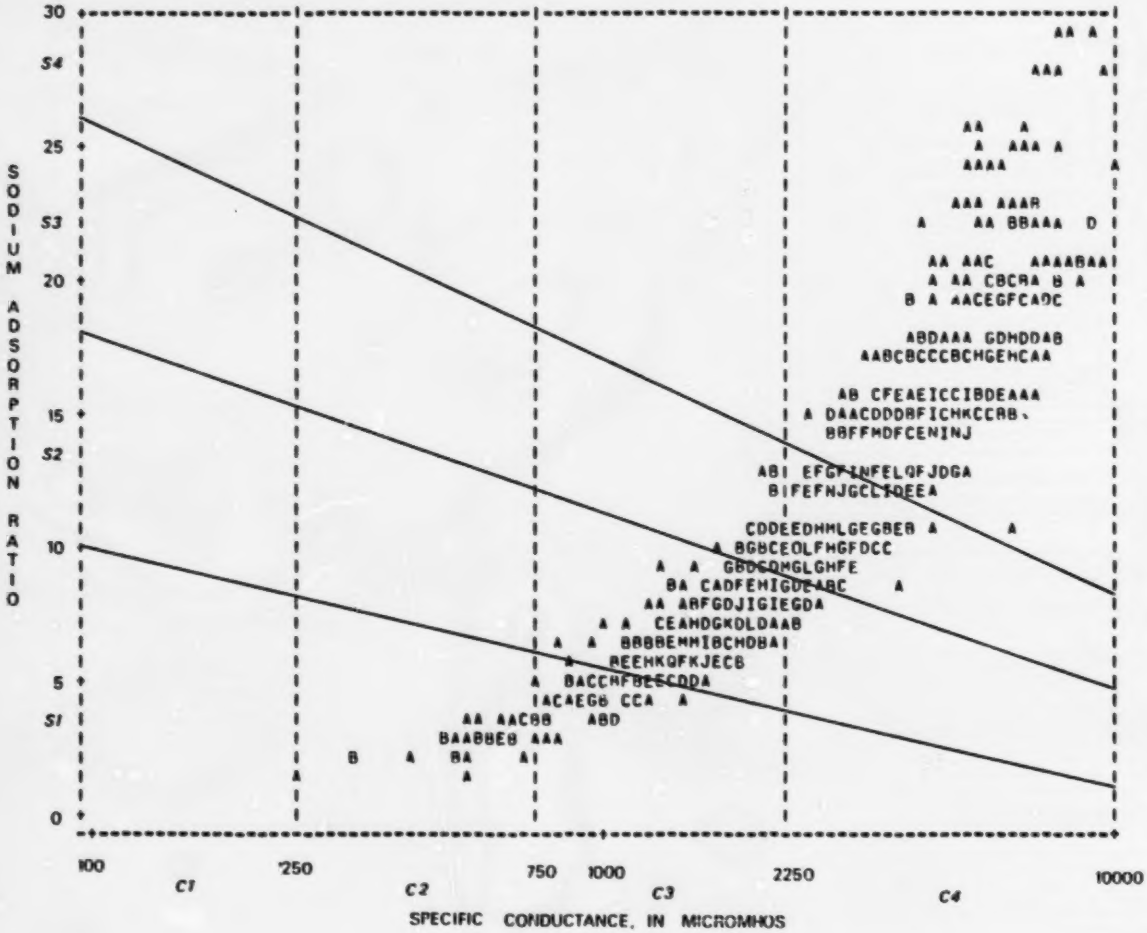


07164500 - Arkansas River at Tulsa, Okla.

LOCATION.--Lat 36°08'13", long 96°00'13", in NW¼ sec.11, T.19 N., R.12 E., Tulsa County, at 11th Street bridge on U.S. Highway 66 in Tulsa, 10.1 mi upstream from Polecat Creek, 15.1 mi downstream from Keystone Dam, and at mile 523.7.

DRAINAGE AREA.--74,615 mi^2, of which 12,541 mi^2 is probably noncontributing.

PERIOD OF RECORD.--1960 to 1961, 1978.

WATER TYPE.--The water at this location was sodium chloride type. For specific conductances greater than 500 mhos, the sodium ion and chloride ion ratios were greater than 50 percent. For specific conductances greater than 1,000 umhos, which occurred in 93 percent of the samples, all of the anion and cation ratios were relatively constant. The approximate cation and anion ratios at these specific conductances were: sodium, 70 percent; calcium, 20 percent; magnesium, 10 percent; chloride, 75 percent; carbonate/bicarbonate, 15 percent; and sulfate, 10 percent.

TREND.--The current period of record was insufficient, less than 5 years, to perform the test for trend.

PUBLIC WATER SUPPLY.--The average hardness of the water was 241 mg/L and was very hard. Eighty-five percent of the samples analyzed had hardness values greater than 180 mg/L, very hard class. The recommended maximum chloride concentration of 250 mg/L was exceeded by 90 percent of the chloride values. Eight samples were analyzed for toxic elements. The maximum contaminant level for cadmium, 10 ug/L, was exceeded in one sample. Because of the frequency of exceedence of the recommended maximum chloride concentration and the indication that cadmium exceeds its maximum contaminant level, this water is probably not suitable for use as a public supply.

IRRIGATION.--The salinity hazard was high or very high. For 50 percent of the samples, the salinity hazard was very high. The sodium hazard ranged from low to very high, with approximately 65 percent of the SAR values in the high or very high sodium hazard classes. The data indicate that phytotoxic effects from boron should not occur.

07164500 - Arkansas River at Tulsa, Okla.--Continued

UNIVARIATE STATISTICS

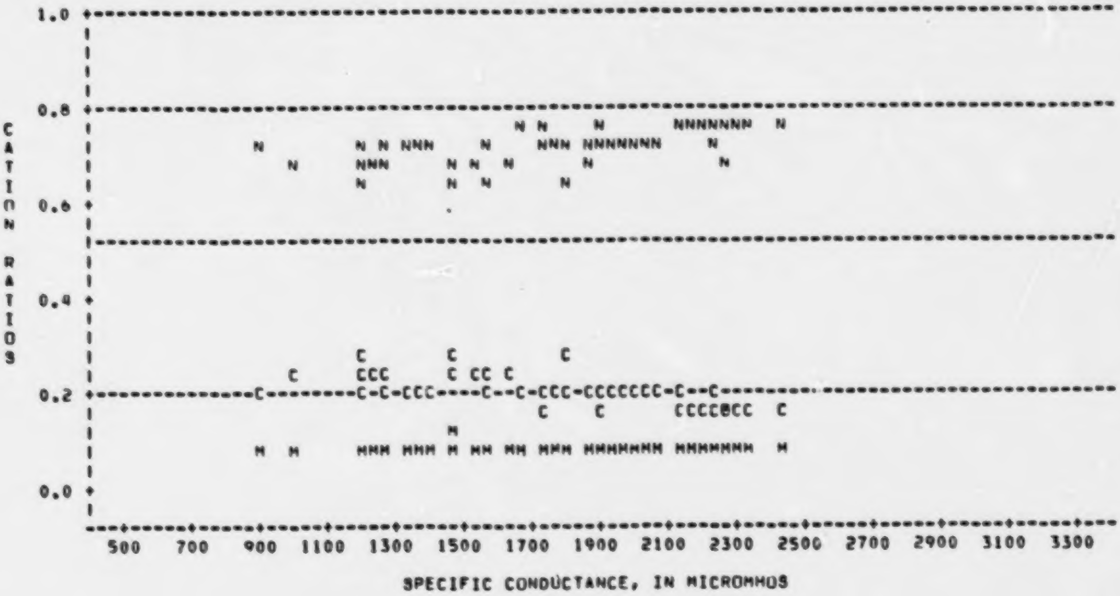
CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	83	1815	326	3400	506	0.26	1.57
Dissolved solids	77	987	108	1910	290	-.26	2.51
pH	85	7.9	6.9	8.8	0.4	.10	-.05
Total hardness	77	241	69	470	64	.49	3.15
Chloride	77	422	15	810	142	-.25	1.38
Sulfate	77	104	19	223	34	.34	1.79
Iron	8	31	10	100			
Fluoride	30	0.4	0.1	0.9	0.2	1.37	3.75
Arsenic	8	2	2	3			
Cadmium	8	2	0	13			
Chromium	8	2	0	20			
Lead	8	6	1	14			
Mercury	8	0.0	0.0	0.1			
SAR	70	7.6	0.5	11	2.0	-1.30	2.81
Boron	7	249	60	520			

FREQUENCY DISTRIBUTION

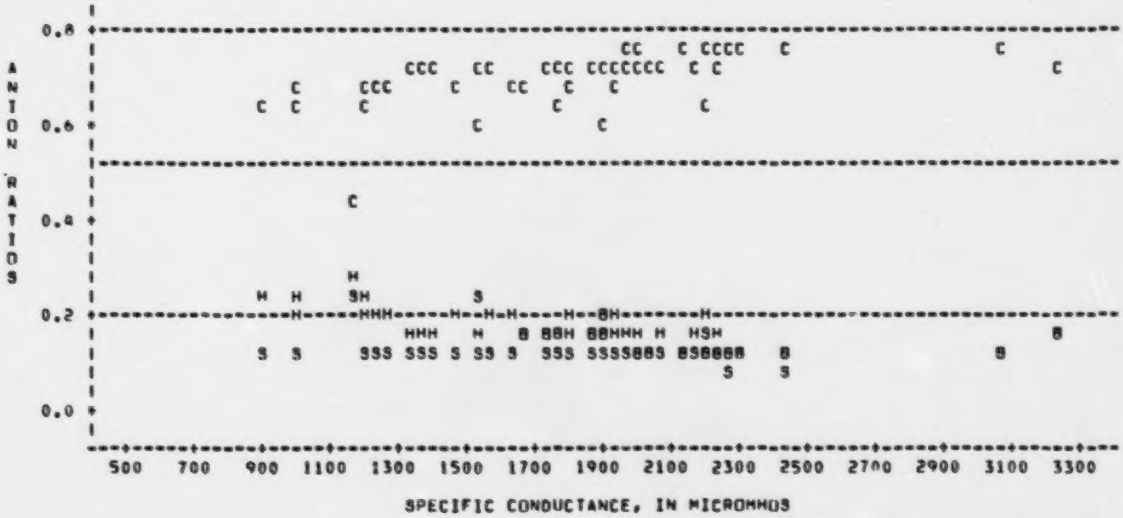
CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	1193	1508	1865	2045	2267
Dissolved solids	654	820	1026	1136	1250
pH	7.4	7.7	7.9	8.2	8.4
Total hardness	168	204	242	259	284
Chloride	242	343	432	489	578
Sulfate	63	81	101	116	136
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	5.3	6.6	7.9	8.8	9.5
Boron					

BEST DOCUMENT AVAILABLE

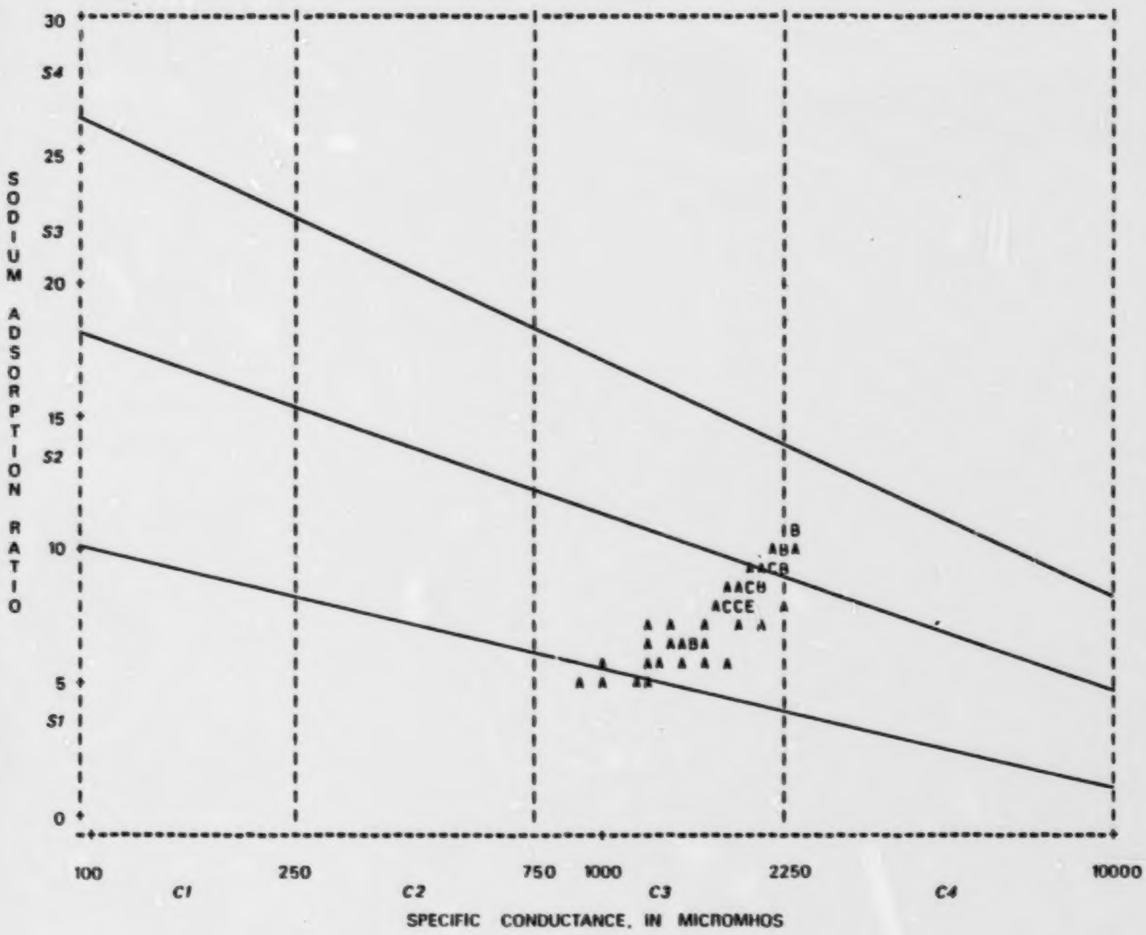
CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT TULSA, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT TULSA, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,   C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,   B = 2 OBS,   C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT TULSA, OK



ARKANSAS RIVER MAINSTEM

07165520 - Arkansas River at Bixby, Okla.

LOCATION.--Lat 36°57'26", long 95°53'10", in SW¼NW¼ sec.2, T.19 N., R.15 E., Wagoner County, at bridge on U.S. Highway 64, 2.0 mi north of Bixby.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1949.

WATER TYPE.--The anion ratio plot shows for the range of specific conductances measured the water was chloride type. Only two analyses were available for the cation ratio plot and these data indicate the water was sodium type. Based on the information from other sampling locations on the Arkansas River, it is presumed water at this location is also sodium chloride type.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 354 mg/L and the water was very hard. Only 8 percent of the samples had hardness values of less than 180 mg/L and were in the hard class, greater than 120 mg/l. The recommended maximum chloride concentration of 250 mg/L was exceeded by 95 percent of the chloride values and the recommended maximum sulfate concentration of 250 mg/L was exceeded by 10 percent of the sulfate values. No toxic element data were available. Water-quality data has not been collected since 1949; therefore, no evaluation has been made as to suitability of water at this location for public supply.

IRRIGATION.--The salinity hazard was high or very high. For 50 percent of the samples the salinity hazard was very high. The sodium hazard ranged from low to very high, with approximately 65 percent of the SAR values in the high or very high sodium hazard class. No boron data were available.

07165520 - Arkansas River at Bixby, Okla.--Continued

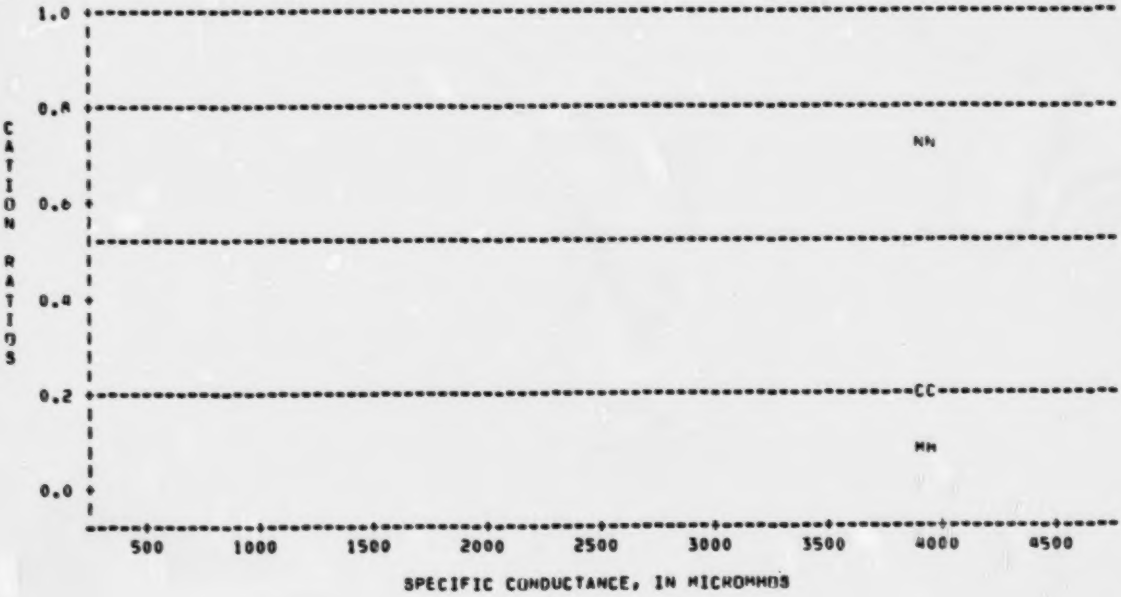
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	99	2331	838	4610	955	0.60	-0.34
Dissolved solids	99	1391	475	2840	597	.64	-.30
pH	2	7.8	7.8	7.9			
Total hardness	99	354	162	648	134	.53	-.57
Chloride	99	600	158	1410	298	.85	.14
Sulfate	99	168	55	437	77	.79	1.28
Iron	0						
Fluoride	2	0.0	0.0	0.0			
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	2	12	12	12			
Boron	0						

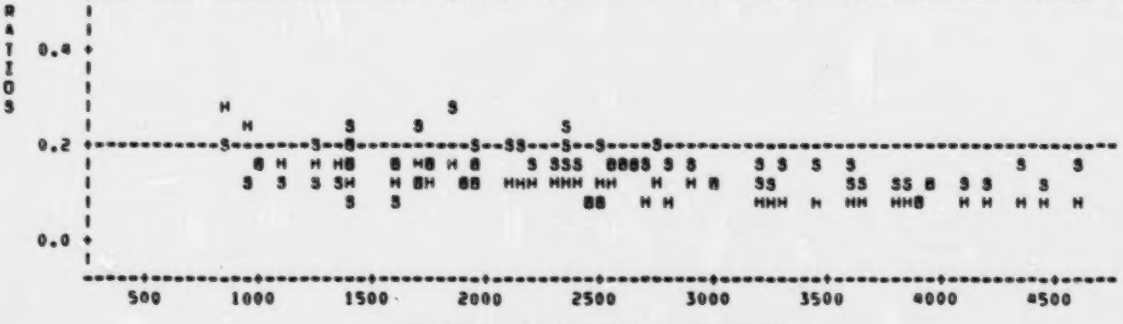
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	1226	1515	2228	2828	3824
Dissolved solids	702	893	1335	1713	2333
pH					
Total hardness	183	230	329	453	570
Chloride	267	377	538	730	1064
Sulfate	69	102	176	216	250
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR					
Boron					

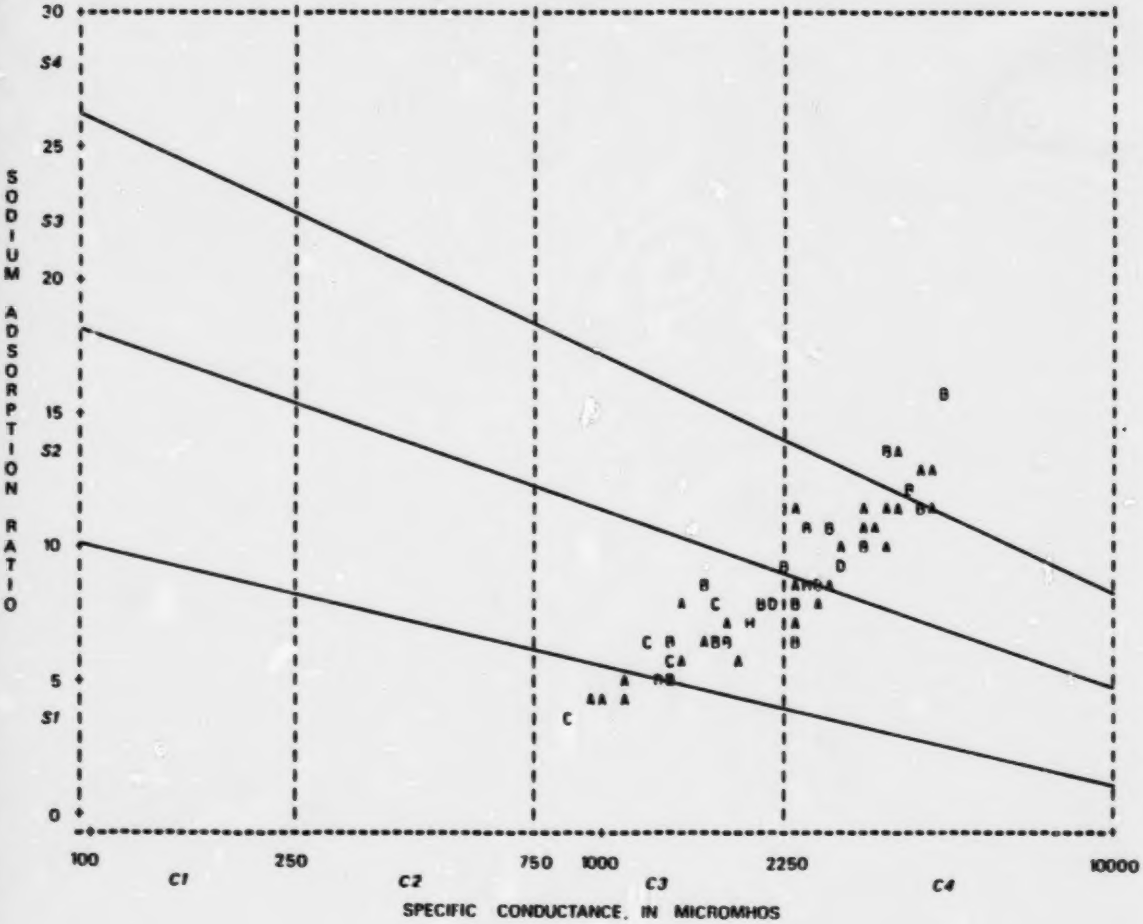
CATION RATIO PLOT
N IS SOL[illegible] ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT BIXBY, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT BIXBY, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD, C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT BIXBY, OK



ARKANSAS RIVER MAINSTEM

07165570 - Arkansas River near Haskell, Okla.

LOCATION.--Lat 35°49'23", long 95°38'39", in NE¼ sec.31, T.16 N., R.16 E., Muskogee County, at bridge on State Highway 104, 2 mi east of Haskell, 23.5 mi upstream from Verdigris River, and at mile 483.7.

DRAINAGE AREA.--75,473 mi^2, of which 12,541 mi^2 is probably noncontributing.

PERIOD OF RECORD.--1974 to 1978.

WATER TYPE.--The data indicate the Arkansas River at this location was primarily sodium chloride type. The cation and anion ratio plots show that both the sodium ion and the chloride ion ratios were greater than 50 percent.

TREND.--Plots of dissolved solids, hardness, chloride, and sulfate versus time did not clearly indicate any trend. However, the Spearman's rhos at the 95-percent probability level for hardness indicated a negative trend and for chloride indicated a positive trend. The Spearman's rhos did not indicate trend for either sulfate or dissolved solids.

PUBLIC WATER SUPPLY.--The average hardness was 260 mg/L and the water was very hard. Hardness was less than 180 mg/L, very hard, for only 3 percent of the hardness values. The recommended pH maximimum of 9.0 was exceeded by 1 percent of the pH values and the recommended maximum chloride concentration of 250 mg/L was exceeded by 83 percent of the chloride values. No toxic element data were available. Because of the frequency of exceedence of the recommended maximum chloride concentration, this water may not be suitable for use as a public supply.

IRRIGATION.--The one sample with sufficient data to plot on the irrigation diagram shows a high salinity hazard and a medium sodium hazard. No boron data were available.

07165570 - Arkansas River near Haskell, Okla.--Continued

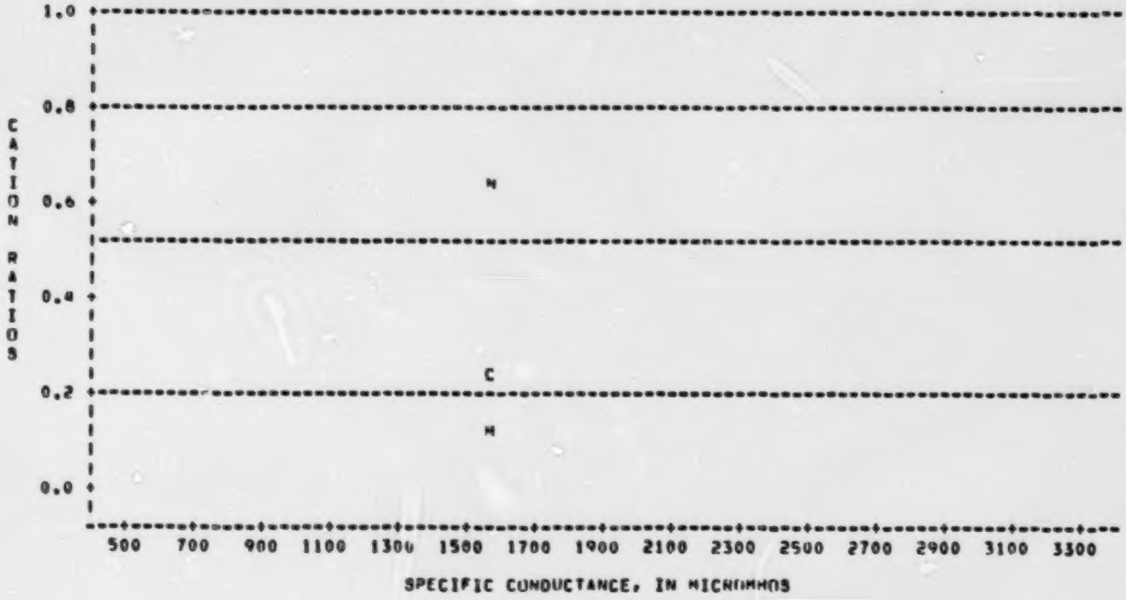
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	76	1558	540	3100	558	0.53	-0.23
Dissolved solids	39	792	327	1410	233	.36	.46
pH	72	8.0	6.8	9.1	0.4	-.37	.51
Total hardness	30	260	126	410	67	.19	-.55
Chloride	48	388	8.0	810	181	.48	-.34
Sulfate	35	94	28	147	29	-.48	-.22
Iron	0						
Fluoride	13	0.3	0.2	0.4	0.1	-.24	-1.05
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	1	5.5					
Boron	0						

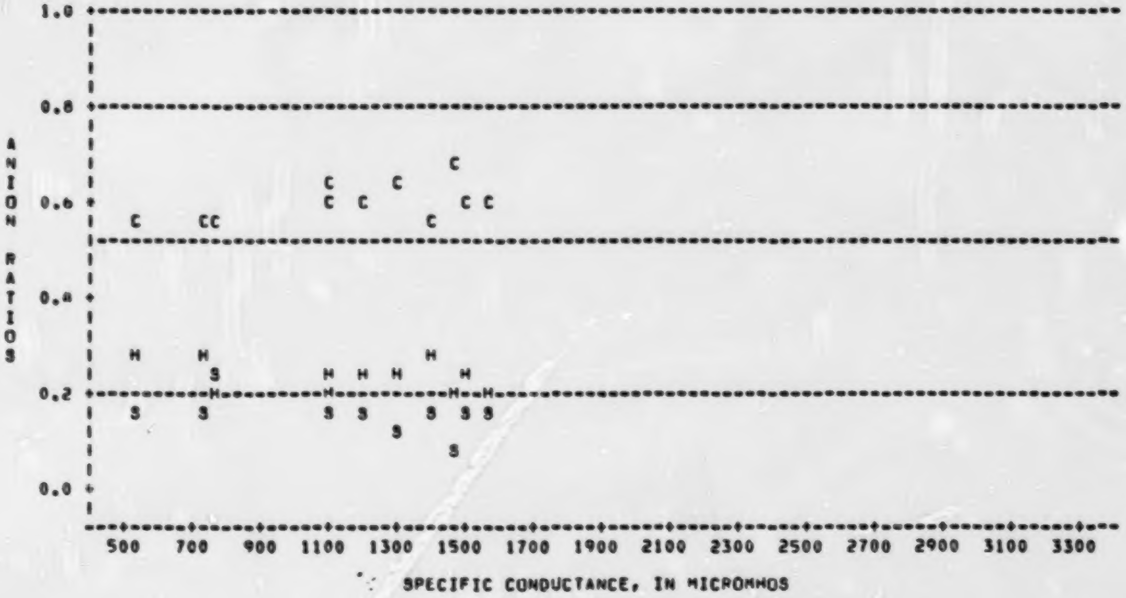
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	902	1100	1490	1900	2428
Dissolved solids	434	674	786	861	1097
pH	7.4	7.8	8.0	8.3	8.6
Total hardness	181	199	241	306	343
Chloride	186	270	320	499	665
Sulfate	50	71	96	115	124
Iron					
Fluoride	0.2	0.2	0.3	0.3	0.4
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR					
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER NR HASKELL, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER NR HASKELL, OK



BEST DOCUMENT AVAILABLE

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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER NR HASKELL, OK
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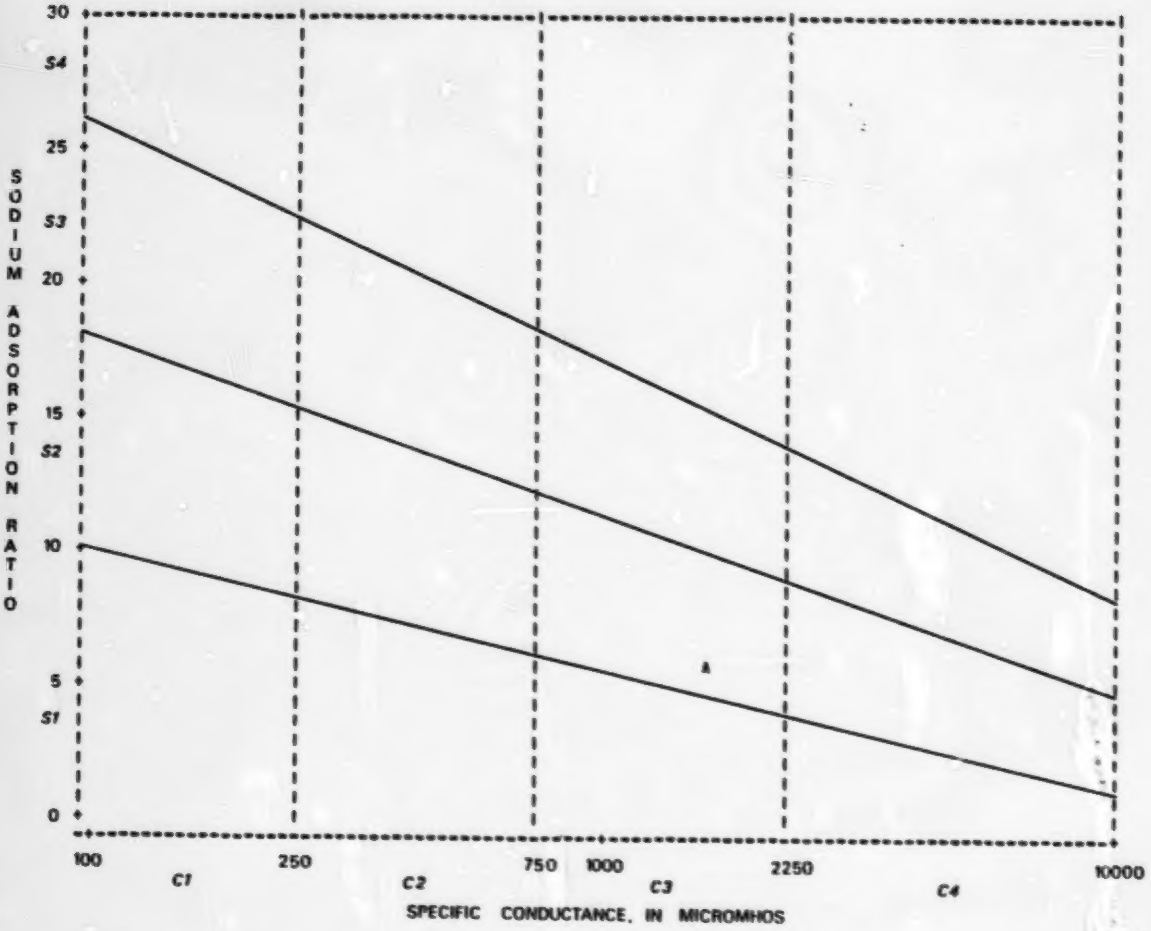

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ARKANSAS RIVER MAINSTEM

07165610 - Arkansas River at Muskogee, Okla.

LOCATION.--Lat 35°47'38", long 95°20'02", in SE¼NW¼ sec.7, T.15 N., R.19 E., Muskogee County, at bridge on State Highway 16, 4 mi northeast of Muskogee.

DRAINAGE AREA.--75,845 mi^2.

PERIOD OF RECORD.--1957, 1962 to 1963.

WATER TYPE.--The water was chloride type throughout the range of specific conductances measured. No data were available for the cation ratio plot. Based on data from other sampling points on the Arkansas River upstream and downstream from this location, the water is presumed to be sodium chloride type.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 340 mg/L, and the water was very hard. Hardness was greater than 180 mg/L, very hard class, for more than 96 percent of the hardness values. The recommended maximum chloride concentration of 250 mg/L was exceeded by more than 95 percent of the chloride values and the recommended maximum sulfate concentration of 250 mg/L was exceeded by less than 5 percent of the sulfate values. No toxic element data were available. Because of the frequency of exceedence of the recommended maximum chloride concentration, this water is probably not suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from high to very high, with approximately 50 percent of the samples having a very high salinity hazard. The sodium hazard ranged from low to very high with about 50 percent of the SAR values in the high or very high sodium hazard classes. No boron data were available.

07165610 - Arkansas River at Muskogee, Okla.--Continued

UNIVARIATE STATISTICS

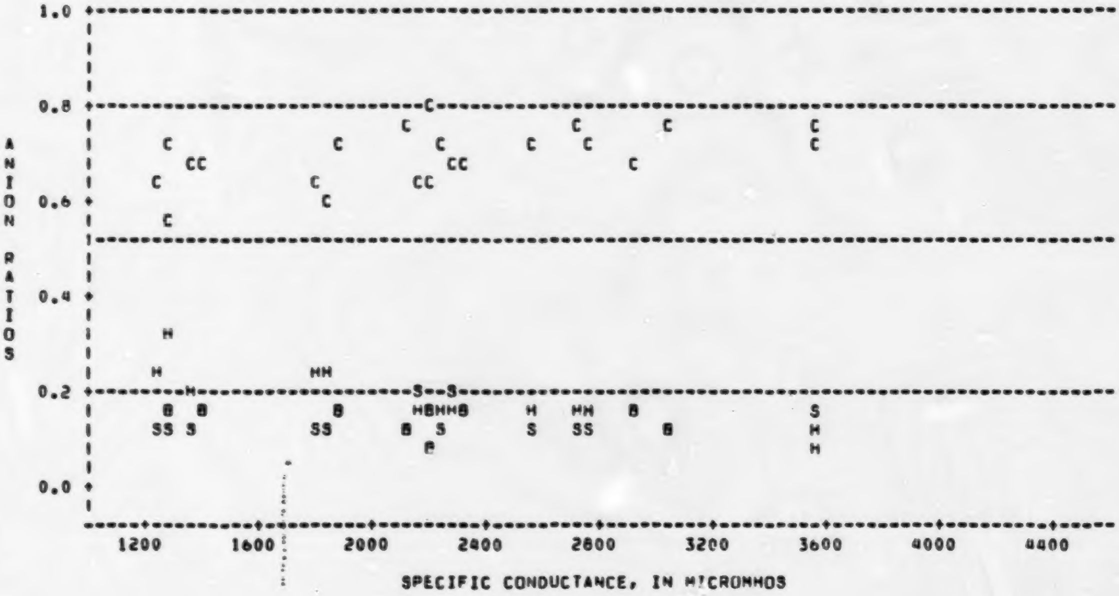
CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	24	2377	1220	4590	877	0.79	0.36
Dissolved solids	24	1318	695	2140	426	.29	-.53
pH	23	8.2	7.3	8.6	0.3	-1.24	1.45
Total hardness	24	340	176	600	104	.49	.38
Chloride	24	577	248	1100	244	.74	-.05
Sulfate	22	144	63	265	58	.57	-.56
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	0						
Boron	0						

FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	1284	1780	2200	2750	3558
Dissolved solids	739	920	1310	1570	1808
pH	7.7	7.9	8.2	8.4	8.5
Total hardness	191	266	340	368	476
Chloride	276	380	532	688	916
Sulfate	71	96	125	182	229
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR					
Boron					

No cation distribution data are available.

ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT MUSKOGEE, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT MUSKOGEE, OK
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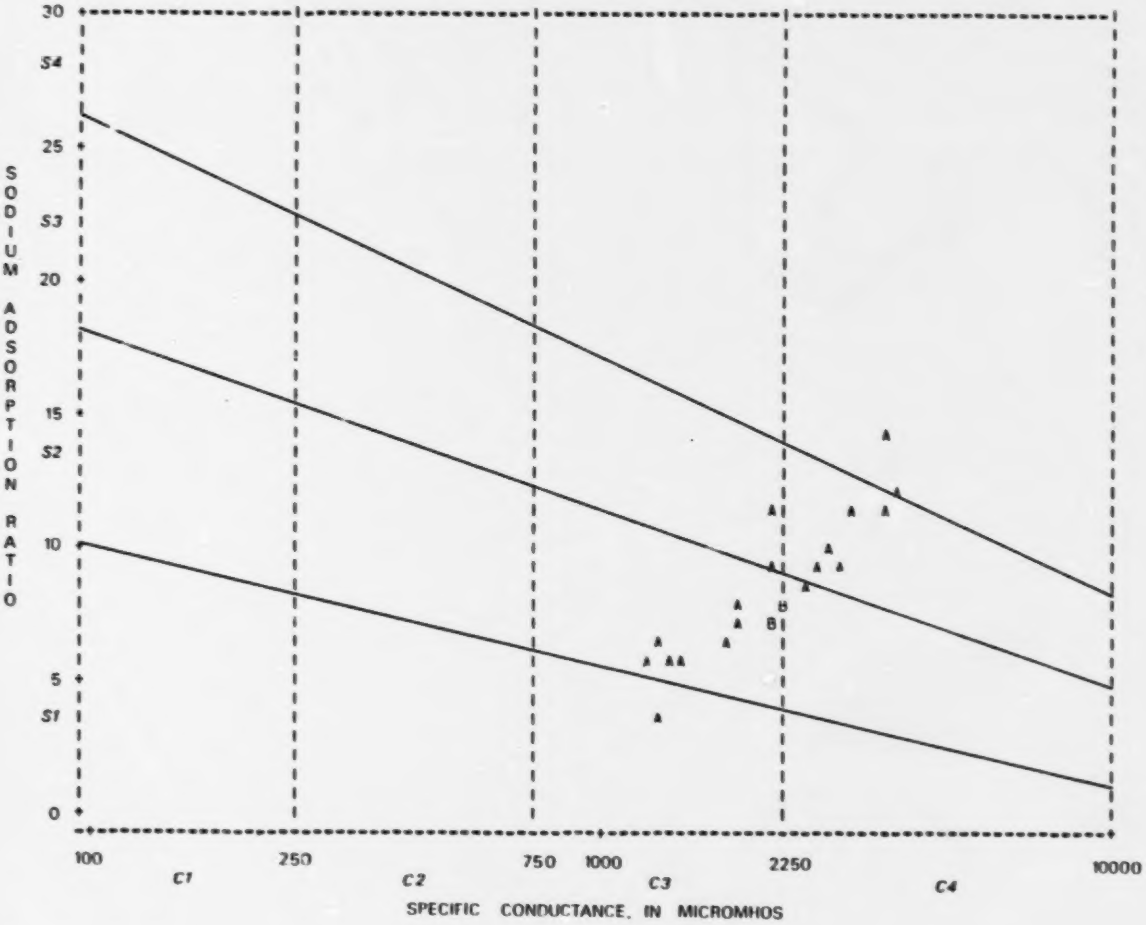


ARKANSAS RIVER MAINSTEM

07194550 - Arkansas River at Webbers Falls, Okla.

LOCATION.--Lat 35°30'50", long 95°07'27", in NE¼SW¼ sec.18, T.12 N., R.21 E., Muskogee County, at bridge on U.S. Highway 46 at Webbers Falls, and at mile 428.4.

DRAINAGE AREA.--97,049 mi^2.

PERIOD OF RECORD.--1949, 1957 to 1963.

WATER TYPE.--The water was sodium chloride type. In 75 percent of the samples, the sodium and chloride ion ratios were greater than 50 percent. For specific conductances of less than about 1,000 umhos, which occurred in 25 percent of the samples, the sodium and chloride ion ratios were less than 50 percent. For these smaller specific conductances, the carbonate/bicarbonate and calcium ion ratios increased and the water was mixed type consisting of calcium, sodium, carbonate/bicarbonate, and chloride ions in about equal ratios. The magnesium and sulfate ion ratios were less than 25 percent at all specific conductances.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 254 mg/L and the water was very hard. For 18 percent of the hardness values, the concentration was less than 180 mg/L. No sample had a hardness of less than 60 mg/L. The recommended maximum chloride concentration of 250 mg/L was exceeded by 63 percent of the chloride values and the recommended maximum sulfate concentration of 250 mg/L was exceeded by 1 percent of the sulfate values. No data were available for the toxic elements. Because of the frequency of exceedence of the recommended maximum chloride concentration, this water may not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to very high, with less than 1 percent of the samples having a low salinity hazard, and 87 percent of the samples in the high or very high classes. The sodium hazard also ranged from low to very high. Less than 5 percent of the SAR values were in the high or very high sodium hazard classes and 55 percent of the SAR values were low sodium hazard class. The data indicate that plants sensitive to boron phytotoxicity could be affected.

07194550 - Arkansas River at Webbers Falls, Okla.--Continued

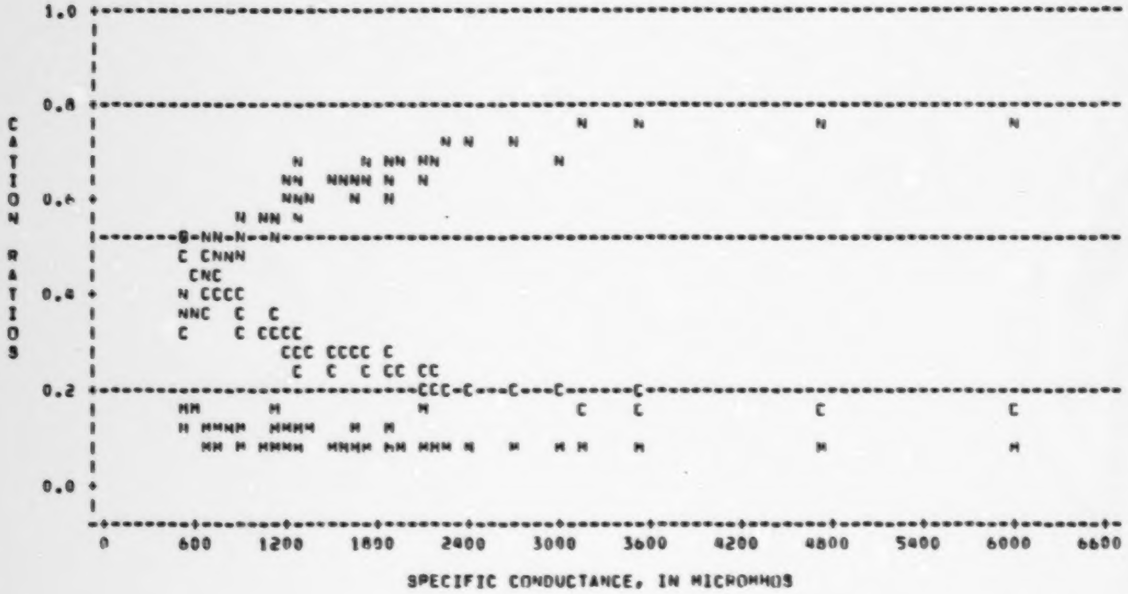
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	649	1468	169	6020	662	1.23	4.15
Dissolved solids	499	873	139	3500	394	1.34	4.54
pH	526	8.0	7.1	8.6	0.2	-.85	1.16
Total hardness	522	254	60	650	80	.66	1.07
Chloride	624	332	22	1800	188	1.70	7.71
Sulfate	501	99	13	292	43	.83	.68
Iron	0						
Fluoride	299	0.4	0.0	0.8	0.1	.60	1.09
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	366	5.6	0.8	17	2.4	.71	1.11
Boron	263	230	0	1000	151	1.22	2.59

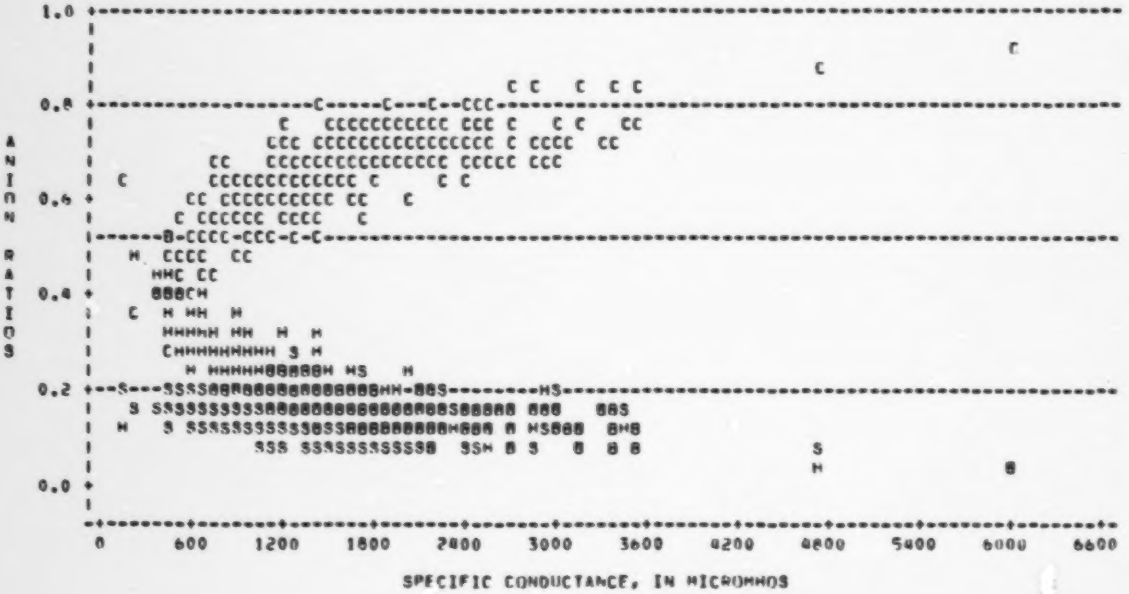
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	692	992	1385	1798	2270
Dissolved solids	414	595	823	1071	1370
pH	7.6	7.8	8.0	8.2	8.3
Total hardness	154	196	250	297	356
Chloride	124	195	303	434	543
Sulfate	51	66	90	123	157
Iron					
Fluoride	0.2	0.3	0.3	0.4	0.5
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	2.6	3.8	5.4	7.0	8.7
Boron	63	131	200	290	419

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT WEBBERS FALLS, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT WEBBERS FALLS, OK



BEST DOCUMENT AVAILABLE

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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT WEBBERS FALLS, OK
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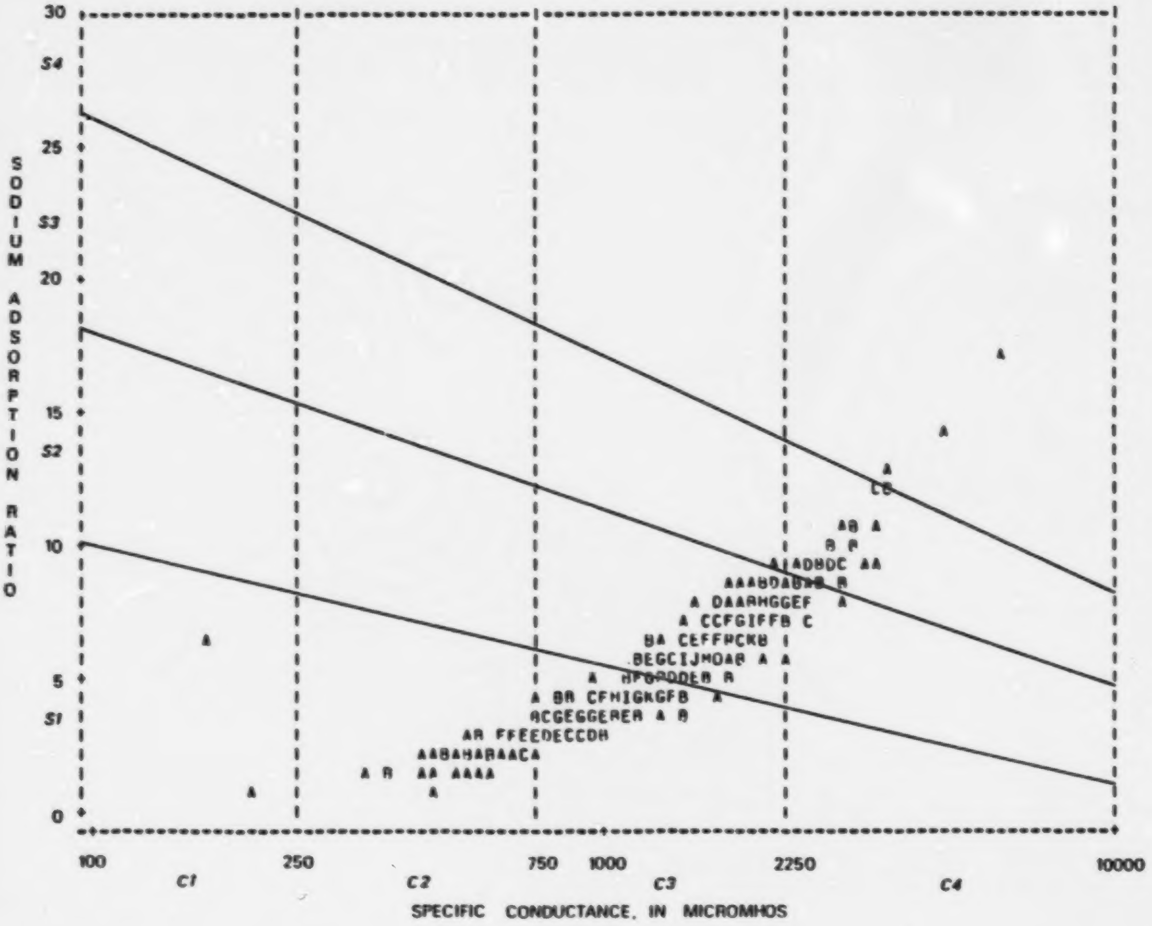


ARKANSAS RIVER MAINSTEM

07246400 - Arkansas River at R.S. Kerr Lock and Dam, near Sallisaw, Okla.

LOCATION.--Lat 35°21'57", long 94°46'43", in SE¼SW¼ sec.8, T.10 N., R.24 E., Sequoyah County, from lock wall at dam, 0.4 mi upstream from gage on bridge on U.S. Highway 59, 3.5 mi downstream from Sans Bois Creek, 7.5 mi south of Sallisaw, and at mile 395.4.

DRAINAGE AREA.--147,750 mi^2, of which 22,241 mi^2 is probably noncontributing.

PERIOD OF RECORD.--1970 to 1978.

WATER TYPE.--The water was sodium chloride type for about 50 percent of the samples. For specific conductances greater than 600 umhos, which occurred in 50 percent of the samples, the sodium and chloride ion ratios were equal to or greater than 50 percent. In the other 50 percent of the samples, the water was sodium, calcium, chloride, carbonate/bicarbonate type with these ions in about equal proportions. The magnesium and sulfate ion ratios were 20 percent or less throughout the range of specific conductance. The change in the Arkansas River at this location from sodium chloride type to a more mixed type of water is probably the result of mixing with the relatively dilute water of the Illinois River.

TREND.--The plots of dissolved solids, hardness, chloride, and sulfate versus time did not indicate any trend. A condition of no trend for these constituents was also determined from the Spearman's rhos at the 95-percent probability level.

PUBLIC WATER SUPPLY.--The average hardness was 141 mg/L and the water was hard. Only 6 percent of the hardness values had a concentration which fell in the very hard class, and 21 percent of the hardness values had concentrations in the moderately hard class, 61 to 120 mg/L. The recommended maximum concentration for chloride of 250 mg/L was exceeded by 3 percent of the chloride values. With the exception of chromium, no data were available for the toxic elements. One analysis was available for chromium, and the concentration did not exceed the maximum contaminant level of 50 ug/L. Based on the available data, this water is probably suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from medium to high, with 75 percent of the samples in the medium class. The sodium hazard at this location was low for 99 percent of the SAR values. No boron data were available.

07246400 - Arkansas River at R.S. Kerr Lock and Dam, near Sallisaw, Okla.--Continued

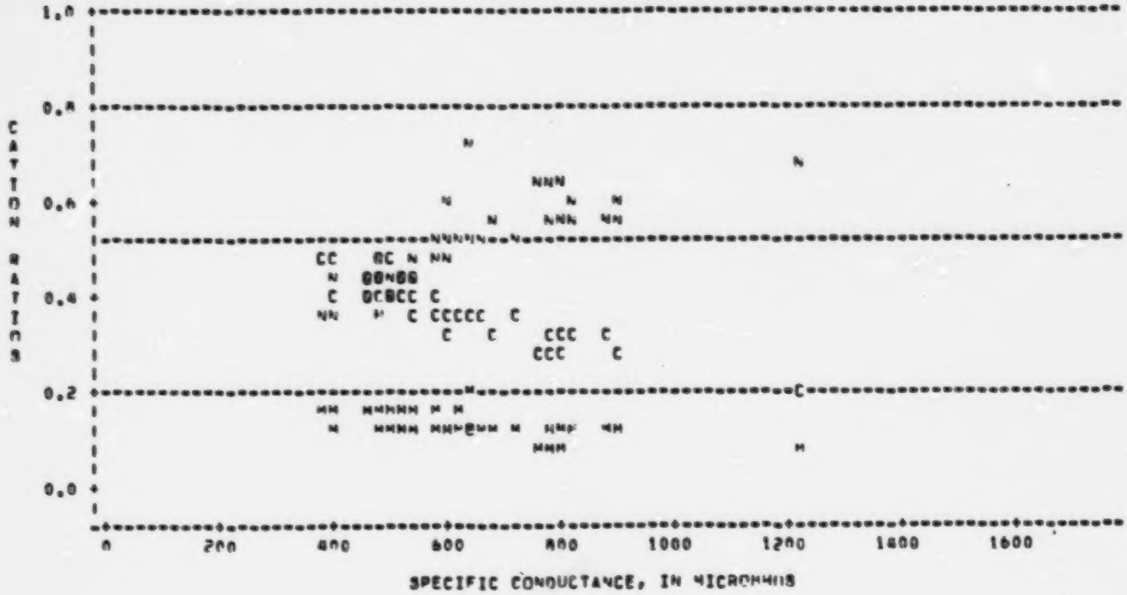
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	188	638	100	1520	216	1.09	2.35
Dissolved solids	81	361	180	740	108	.89	.92
pH	155	7.9	6.7	9.0	0.5	-.11	.39
Total hardness	82	141	66	207	22	.11	1.59
Chloride	84	112	17	412	59	2.02	7.74
Sulfate	85	46	23	76	11	.60	.44
Iron	0						
Fluoride	5	0.3	0.2	0.3			
Arsenic	0						
Cadmium	0						
Chromium	1	0					
Lead	0						
Mercury	0						
SAR	79	2.6	1.1	6.0	1.0	.78	.60
Boron	0						

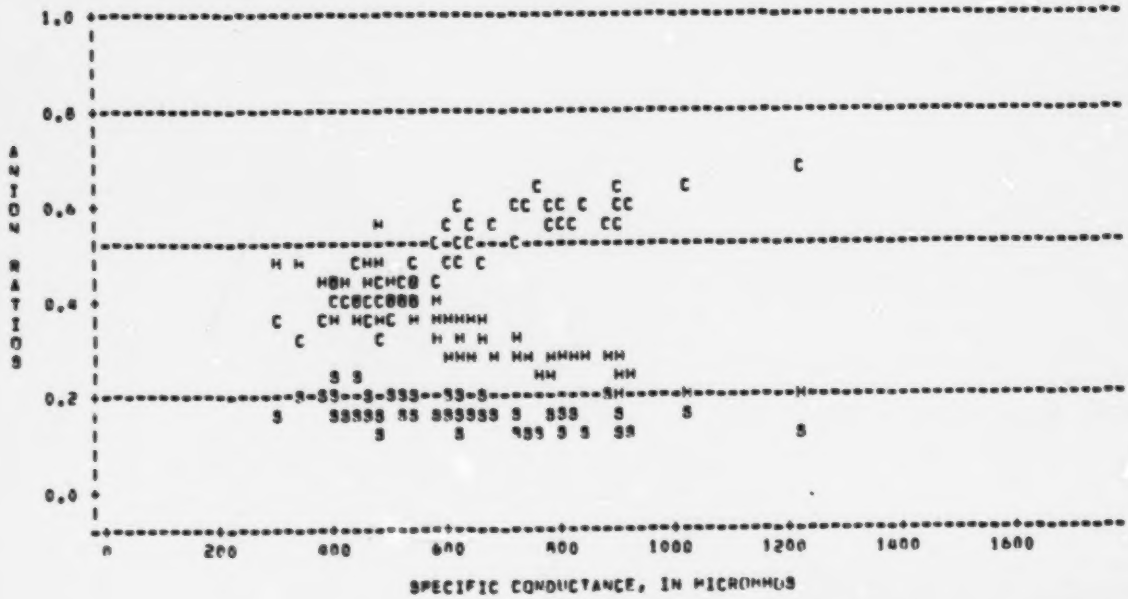
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	398	487	600	750	897
Dissolved solids	241	281	343	426	510
pH	7.2	7.6	7.9	8.2	8.5
Total hardness	115	127	140	151	168
Chloride	56	70	99	148	173
Sulfate	32	38	44	52	60
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	1.5	1.7	2.5	3.2	3.8
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=R.S. KERR LOCK & DAM NR SALLISAW OK

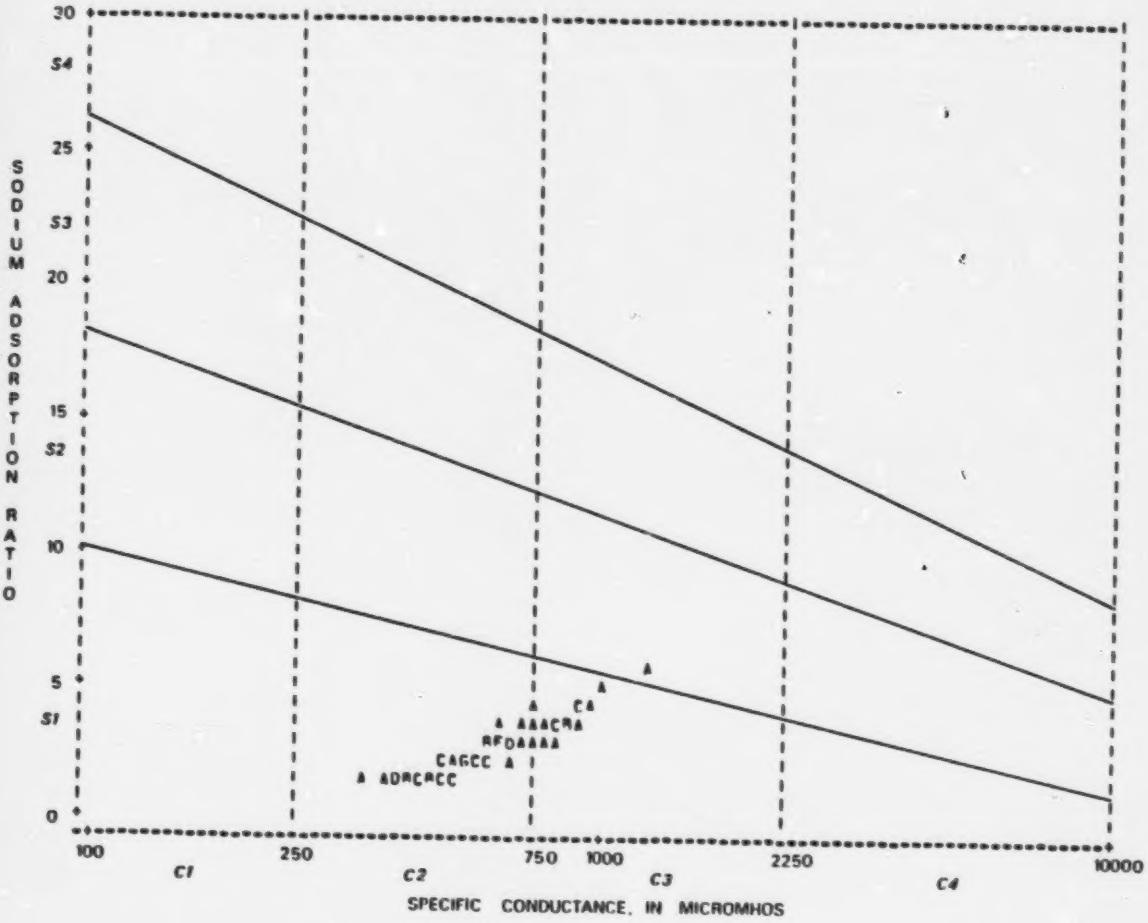


ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=R.S. KERR LOCK & DAM NR SALLISAW OK



BEST DOCUMENT AVAILABLE

IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD, C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=R.S. KERR LOCK & DAM NR SALLISAW OK



ARKANSAS RIVER MAINSTEM

07246500 - Arkansas River near Sallisaw, Okla.

LOCATION.--Lat 35°18'02", long 94°37'16", in NE¼NE¼ sec.35, T.10 N., R.25 E., Sequoyah County, at Kansas City Southern Railroad Co. bridge, 0.5 mi south of Redlands, 4 mi downstream from Cache Creek, 14 mi southeast of Sallisaw, and at mile 380.0.

DRAINAGE AREA.--147,898 mi^2, of which 22,241 mi^2 is probably noncontributing.

PERIOD OF RECORD.--1957, 1959 to 1963.

WATER TYPE.--The water was predominately sodium chloride type. For specific conductances less than 700 umhos, which occurred in 17 percent of the samples, the sodium and chloride ion ratios were generally less than 50 percent. At these smaller specific conductances, the water was a sodium, calcium, carbonate/bicarbonate, chloride mixed type water. The magnesium and sulfate ion ratios were relatively constant at about 15 to 20 percent throughout the range of measured specific conductances. The last samples were taken in 1963, prior to the construction of Robert S. Kerr Lock and Dam, and probably represent river conditions at that time.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 227 mg/L and the water was very hard. Hardness concentrations greater than 180 mg/L, very hard class, occurred for 75 percent of the hardness values. Less than 4 percent of the hardness values had concentrations of 61 to 120 mg/L, moderately hard class, and none of the values were in the soft class. The recommended maximum chloride concentration of 250 mg/L was exceeded by 39 percent of the chloride values. No toxic element data were available. Because of the frequency of exceedence of the recommended maximum concentration by chloride, the suitability of this water for use as a public supply may be questionable.

IRRIGATION.--The salinity hazard ranged from medium to very high, with 78 percent of the samples in the high salinity hazard class. The sodium hazard ranged from low to high with 75 percent of the SAR values in the low sodium hazard class. Boron concentrations were such that very sensitive plants could show adverse affects.

07246500 - Arkansas River near Sallisaw, Okla.--Continued

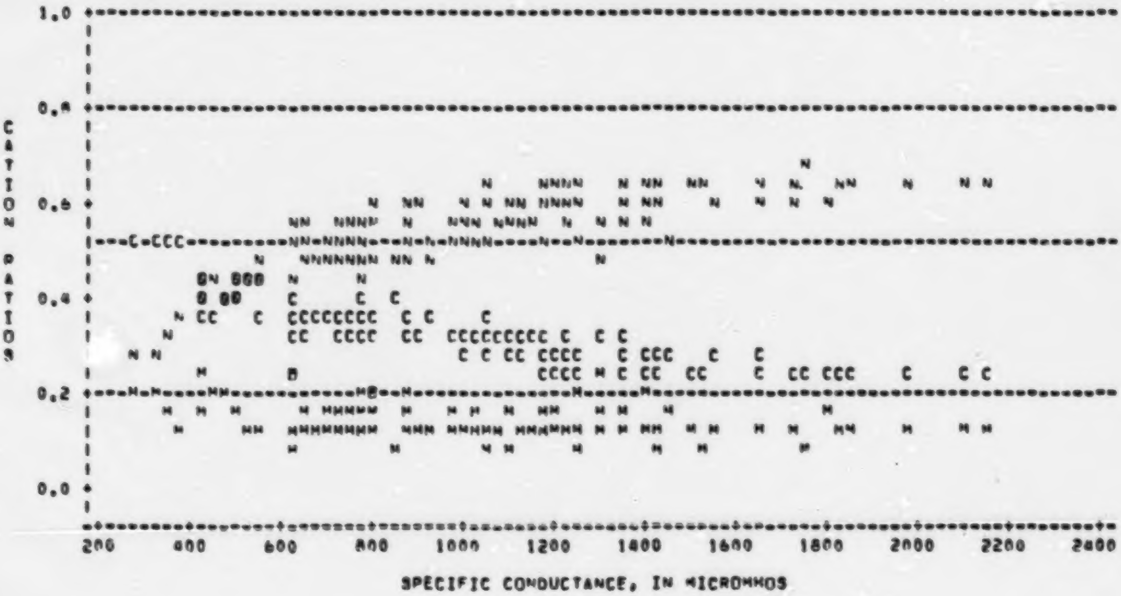
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	225	1127	279	2350	434	0.48	-0.17
Dissolved solids	224	666	169	1380	261	.54	-.06
pH	225	8.1	7.0	8.6	0.3	-.94	.71
Total hardness	225	227	104	385	62	.26	-.50
Chloride	225	231	28	575	114	.63	.00
Sulfate	224	81	15	172	31	.37	-.34
Iron	0						
Fluoride	25	0.3	0.0	0.6	0.2	.46	-.56
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	225	4.0	0.7	10	1.6	.49	.40
Boron	20	217	0	940	221	2.08	5.42

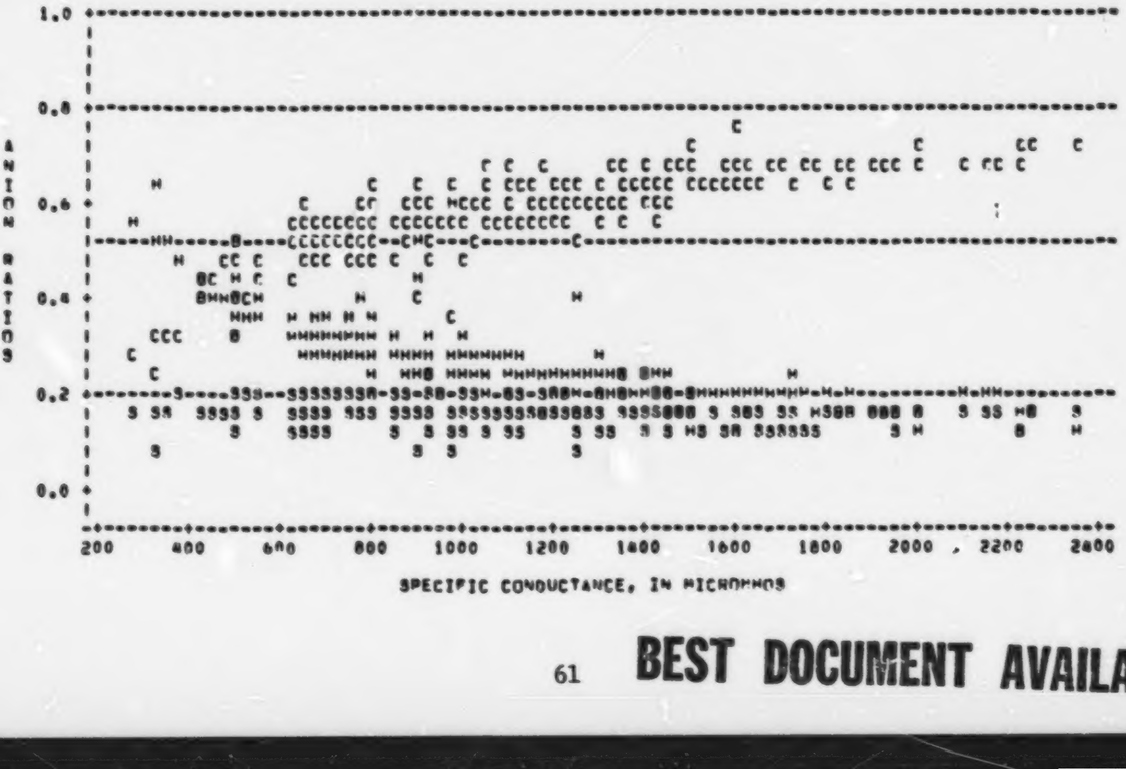
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	626	781	1065	1400	1710
Dissolved solids	359	459	633	829	1020
pH	7.5	7.8	8.1	8.2	8.3
Total hardness	143	180	223	270	312
Chloride	106	139	216	298	382
Sulfate	39	58	78	99	126
Iron					
Fluoride	0.1	0.2	0.2	0.4	0.5
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	2.0	2.8	3.9	5.0	6.0
Boron	10	90	150	240	400

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER NR SALLISAW, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER NR SALLISAW, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER NR SALLISAW, OK
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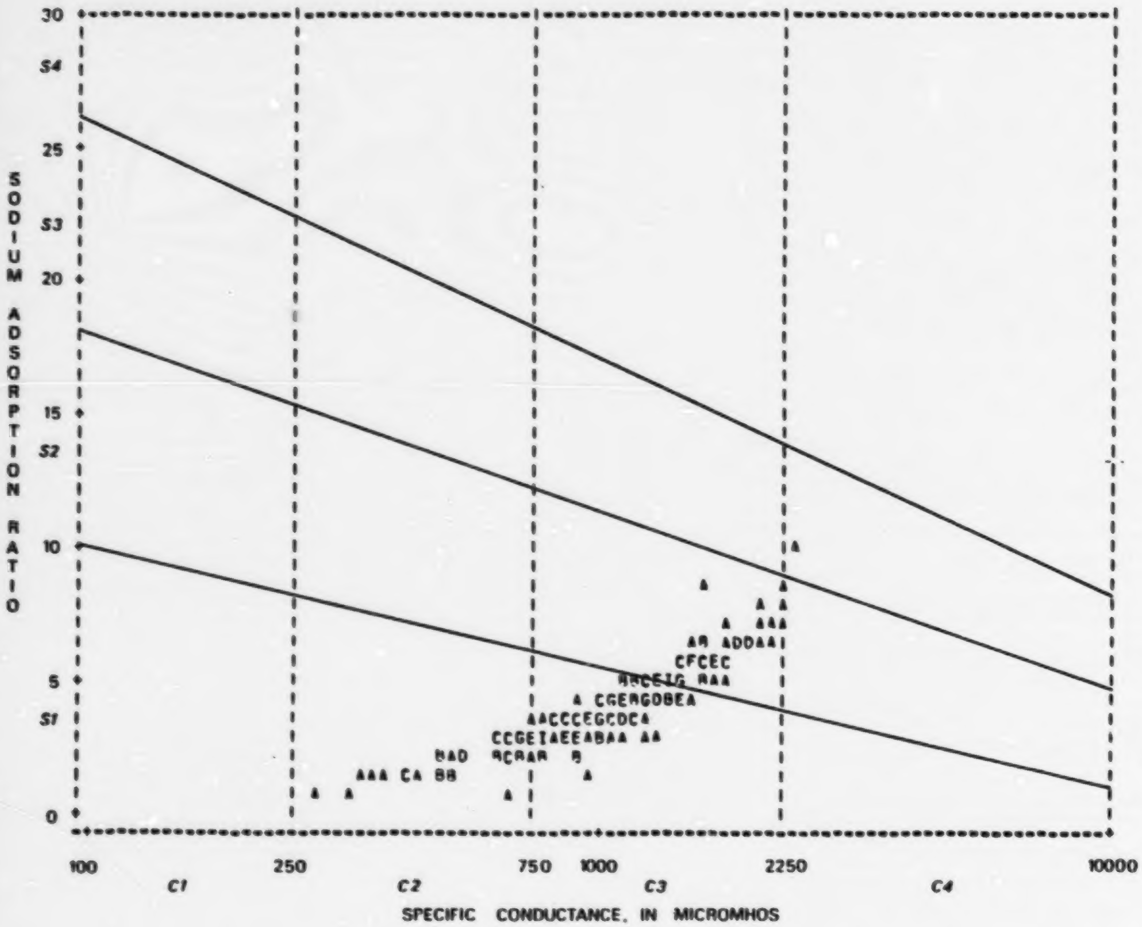


ARKANSAS RIVER MAINSTEM

07250500 - Arkansas River at Van Buren, Ark.

LOCATION.--Lat 35°25'42", long 94°21'37", in NE¼NW¼ sec.36, T.9 N., R.32 W., Sebastian County, at bridge on U.S. Highways 64 and 71 at Van Buren, 1.3 mi downstream from Lee Creek, 8.6 mi downstream from Poteau River, and at mile 353.4.

DRAINAGE AREA.--150,843 mi^2, of which 22,241 mi^2 is probably noncontributing.

PERIOD OF RECORD.--1945 to 1970, 1974 to 1977.

REMARKS.--Water-quality samples were collected during 1960 and 1961 by the Oklahoma District, U.S. Geological Survey. All other water-quality samples were collected by the Arkansas District, U.S. Geological Survey.

WATER TYPE.--The water was predominately sodium chloride type. For specific conductance greater than 1,000 umhos, which occurred in 58 percent of the samples, the chloride and the sodium ion ratios were rarely less than 50 percent. In the samples where the specific conductance was less than 1,000 umhos, the calcium ratio increased as the specific conductance decreased and reached a maximum of 50 percent. The carbonate/bicarbonate and the sulfate ion ratios both increased as the specific conductance decreased, and reached maximums of about 50 percent and 25 percent, respectively. Therefore, for specific conductances less than 1,000 umhos, the water was mixed type.

TREND.--Plots of dissolved solids, hardness, sulfate, and chloride versus time indicated the constituent values were smaller during the post 1973 period than during the pre 1971 period of record. The Spearman's rhos for these constituents indicated at the 95-percent probability level that a trend of decreasing concentration occurred. However, the tests are inconclusive because of the missing 3-year period of 1971 to 1973.

PUBLIC WATER SUPPLY.--The average hardness was 216 mg/L and the water was very hard. The hardness was equal to or greater than 180 mg/L for 64 percent of the hardness values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 49 percent of the chloride values and the recommended maximum iron concentration of 300 ug/L was exceeded by 34 percent of the iron values. The maximum fluoride contaminant level of 1.6 mg/L for the average annual maximum daily air temperature of 73.0°F at Van Buren was exceeded by one sample, which had a concentration of 1.8 mg/L. The toxic element data indicated that maximum contaminant levels would not be exceeded. Because of the frequencies of exceedence of recommended maximum concentrations by chloride and iron, this water may not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to very high. The salinity hazard was high or very high in 74 percent of the samples. The sodium hazard also ranged from low to very high, with about 8 percent of the SAR values in the high or very high sodium hazard classes. In 3 of 700 samples, the boron concentration was high enough, greater than 750 ug/L, that sensitive plants could be affected, and in 1 sample, the boron concentration was high enough, greater than 1,000 mg/L, that semi-tolerant plants could be affected.

07250500 - Arkansas River at Van Buren, Ark.--Continued

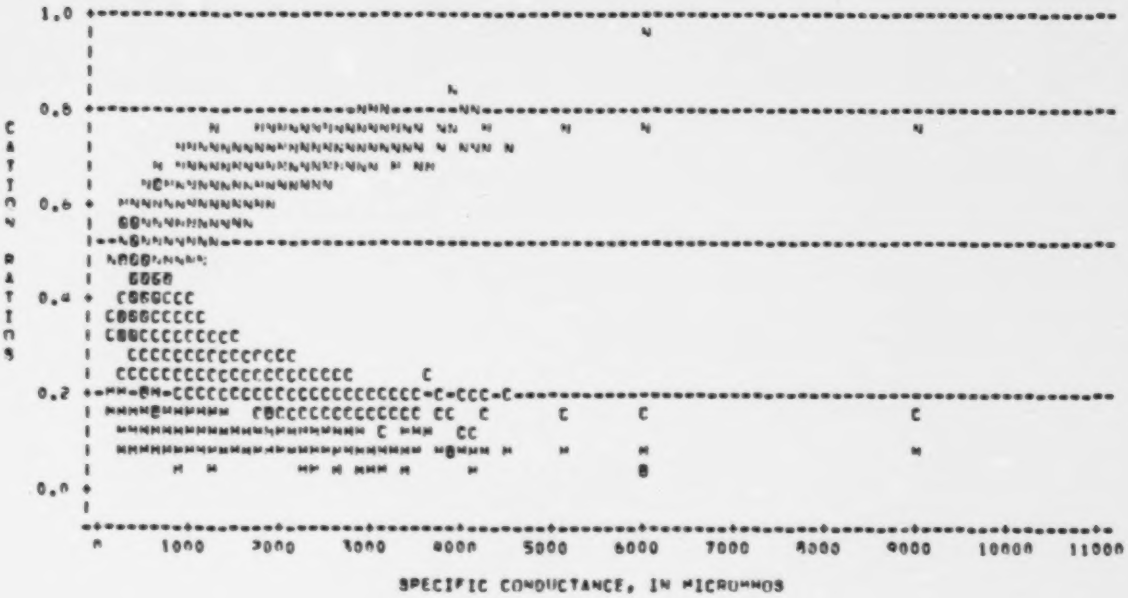
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	1693	1298	104	8980	774	1.79	7.95
Dissolved solids	1592	774	62	5830	451	2.12	12.58
pH	1355	7.8	4.9	8.9	0.4	-.67	1.79
Total hardness	1637	216	26	1100	87	1.38	7.45
Chloride	1665	305	15	3000	230	2.31	13.99
Sulfate	1568	67	6.2	214	31	.74	.63
Iron	11	222	0	570	212	.66	-1.26
Fluoride	626	0.4	0.0	1.8	0.3	1.69	4.95
Arsenic	0						
Cadmium	1	0					
Chromium	1	5					
Lead	2	9	8	10			
Mercury	0						
SAR	1549	5.1	0.7	25	2.6	1.17	3.31
Boron	700	88	0	1500	112	5.62	54.98

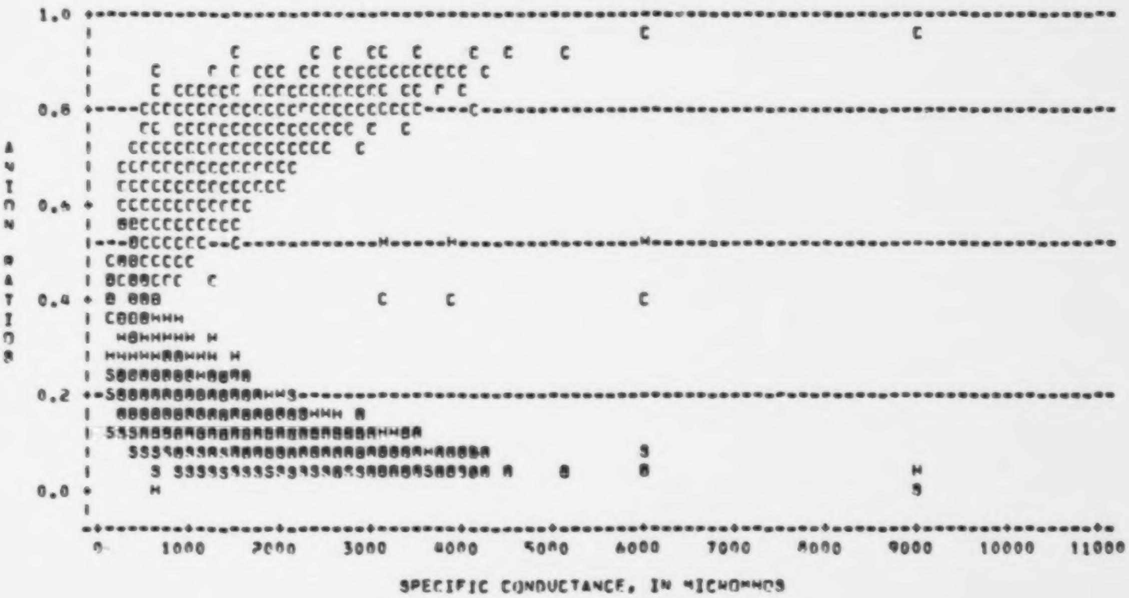
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	498	735	1136	1661	2289
Dissolved solids	308	451	688	986	1337
pH	7.2	7.5	7.8	8.1	8.3
Total hardness	117	154	205	263	326
Chloride	82	141	250	403	600
Sulfate	30	44	63	86	110
Iron	0	28	122	370	514
Fluoride	0.0	0.2	0.3	0.4	0.6
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	2.1	3.1	4.6	6.6	8.5
Boron	0	23	50	100	180

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT VAN BUREN, ARK.



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT VAN BUREN, ARK.



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=ARKANSAS RIVER AT VAN BUREN, ARK.
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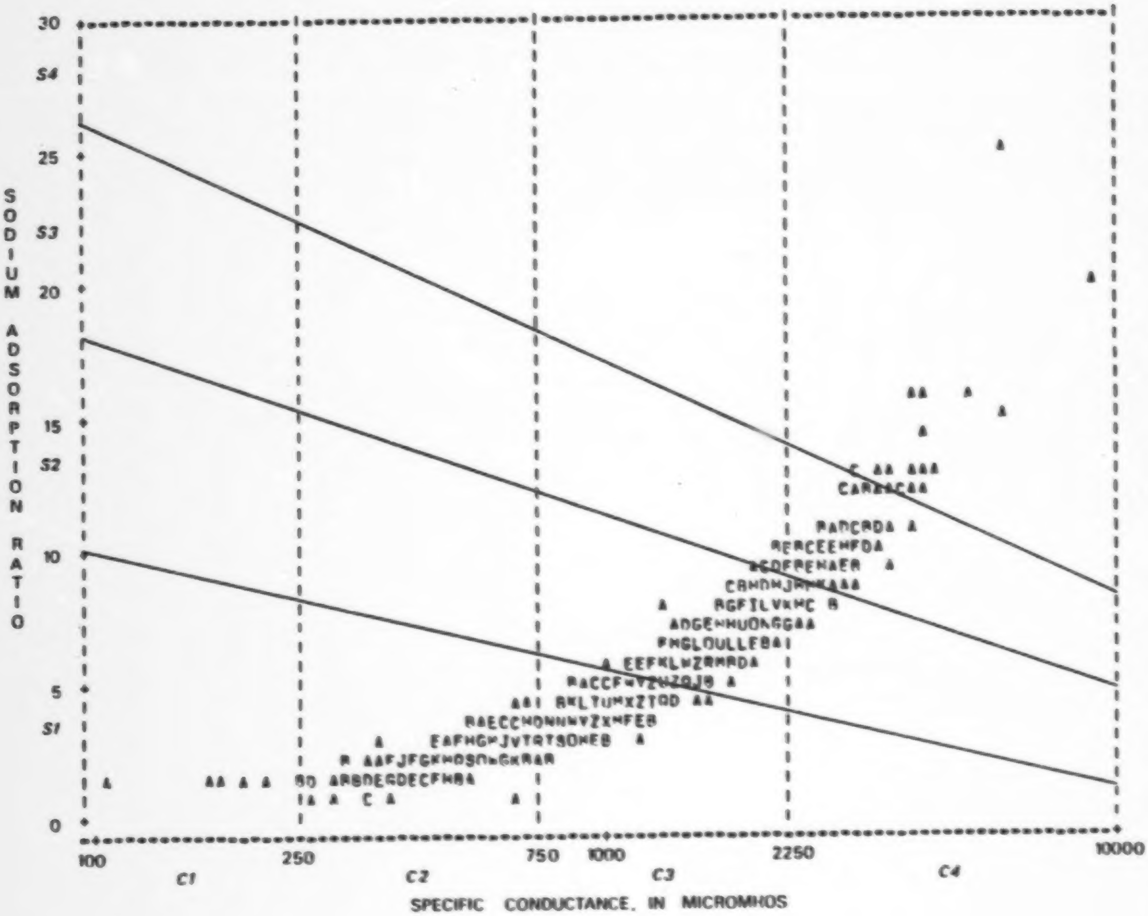


ARKANSAS RIVER MAINSTEM

07153000 - Black Bear Creek at Pawnee, Okla.

LOCATION.--Lat 36°20'37", long 96°47'57", on east line of SE¼NE¼ sec.31, T.22 N., R.5 E., Pawnee County, at bridge on State Highway 18 in north Pawnee, 300 ft downstream from Skedee Creek, and at mile 23.4.

DRAINAGE AREA.--576 mi^2.

PERIOD OF RECORD.--1952 to 1953, 1956 to 1959, 1961 to 1971, 1978.

WATER TYPE.--For specific conductances greater than 3,000 umhos, which occurred in 8 percent of the samples, the water was sodium chloride type, with the chloride ion ratio greater than 80 percent and the sodium ion ratio about 55 percent. For the 92 percent of the samples where the specific conductance was less than 3,000 umhos, the water was a sodium, calcium, chloride, carbonate/bicarbonate mixed type.

TREND.--The period of record for current data was insufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 390 mg/L and the water was very hard. Hardness concentrations were greater than 180 mg/L for 69 percent of the hardness values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 45 percent of the chloride values. No toxic element data were available. Because of the frequency of exceedence of the recommended maximum chloride concentration, this water is probably not suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to very high, with 63 percent of the samples having a high or very high salinity hazard. The sodium hazard also ranged from low to very high. However, only 4 percent of the SAR values had a high or very high sodium hazard. No boron data were available.

07153000 - Black Bear Creek at Pawnee, Okla.--Continued

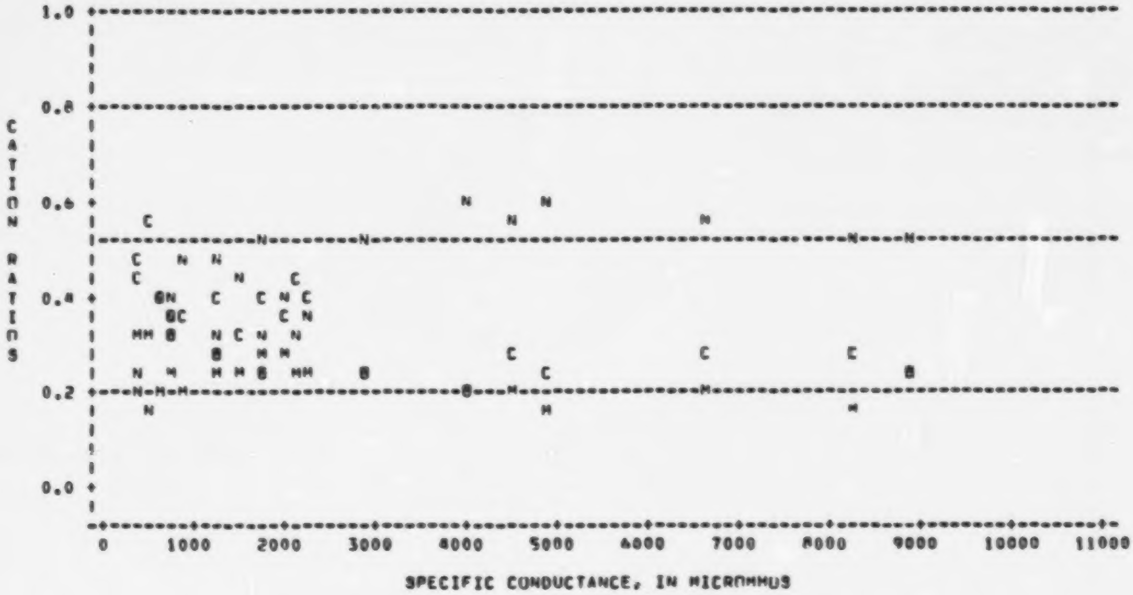
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	149	1453	155	8920	1404	2.64	9.42
Dissolved solids	61	824	94	2860	680	1.33	1.45
pH	119	7.7	5.9	8.6	0.4	-.75	1.60
Total hardness	91	390	58	2260	365	2.72	9.86
Chloride	146	360	11	2900	442	2.97	11.78
Sulfate	65	34	9.7	119	19	1.62	5.07
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	84	3.5	0.4	10	2.0	1.03	0.65
Boron	0						

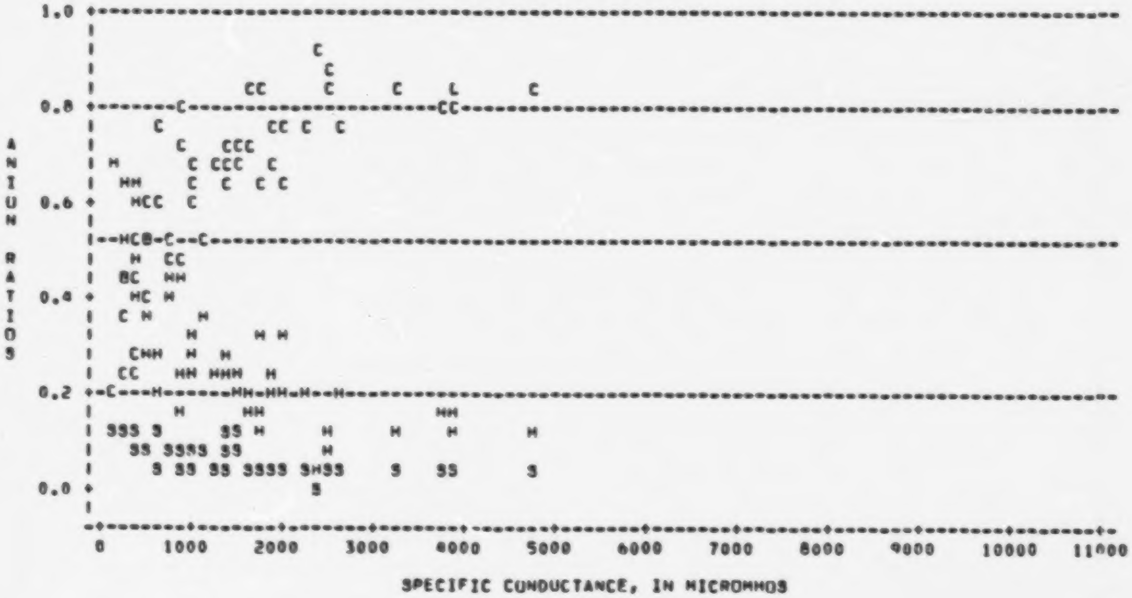
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	301	503	1020	1867	2608
Dissolved solids	173	269	607	1118	1558
pH	7.2	7.4	7.7	8.0	8.2
Total hardness	108	160	268	503	713
Chloride	37	86	215	456	734
Sulfate	15	19	32	46	54
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	1.1	1.8	2.9	4.7	6.7
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BLACK BEAR CREEK AT PAWNEE, OK

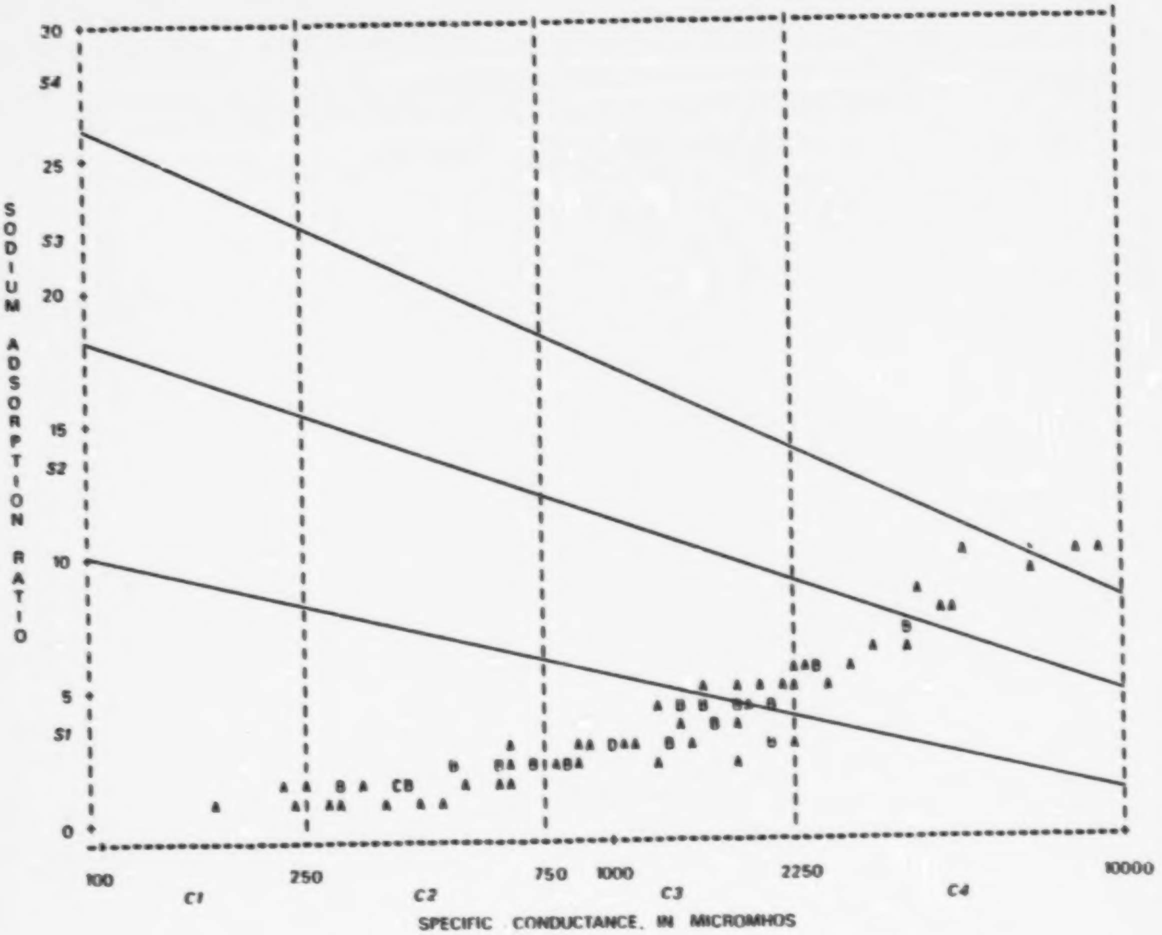


ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BLACK BEAR CREEK AT PAWNEE, OK



BEST DOCUMENT AVAILABLE

IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD, C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=BLACK BEAR CREEK AT PAWNEE, OK



07249200 - Brazil Creek near Panama, Okla.

LOCATION.--Lat 35°08'15", long 94°40'20", in SW¼SE¼ sec.21, T.8 N., R.25 E., LeFlore County, at bridge on U.S. Highway 59, 1.5 mi south of Panama.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1960 to 1961.

WATER TYPE.--The water was generally sulfate type with no predominant cation. The sulfate ion ratio was greater than 50 percent, when the specific conductance was greater than 125 umhos, which occurred in 60 percent of the samples.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 41 mg/L and the water was soft. Less than 10 percent of the hardness values were greater than 60 mg/L, the upper limit for the soft class. No data were available for the toxic elements. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium, with 93 percent of the samples having a low salinity hazard. The sodium hazard was low for all SAR values. No boron data were available.

07249200 - Brazil Creek near Panama, Okla.--Continued

UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	14	158	80	400	76	2.72	8.84
Dissolved solids	12	101	55	264	56	2.54	7.34
pH	14	7.6	7.1	8.0	0.2	-.40	.16
Total hardness	14	46	25	138	28	3.00	10.09
Chloride	14	5.7	2.2	10	2.1	.43	-.03
Sulfate	12	38	16	118	27	2.88	9.15
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	12	0.9	0.5	1.4	0.2	.53	-.05
Boron	0						

FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	90	119	130	170	182
Dissolved solids	56	69	80	109	127
pH	7.1	7.3	7.6	7.7	7.8
Total hardness	26	31	36	49	54
Chloride	2.3	4.0	5.6	6.4	8.3
Sulfate	18	25	30	35	45
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.5	0.7	0.8	1.0	1.2
Boron					

BEST DOCUMENT AVAILABLE

```
CATION RATIO PLOT
N IS SODIUM ION RATIO,  C IS CALCIUM ION RATIO,  M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BRAZIL CREEK NR PANAMA, OK
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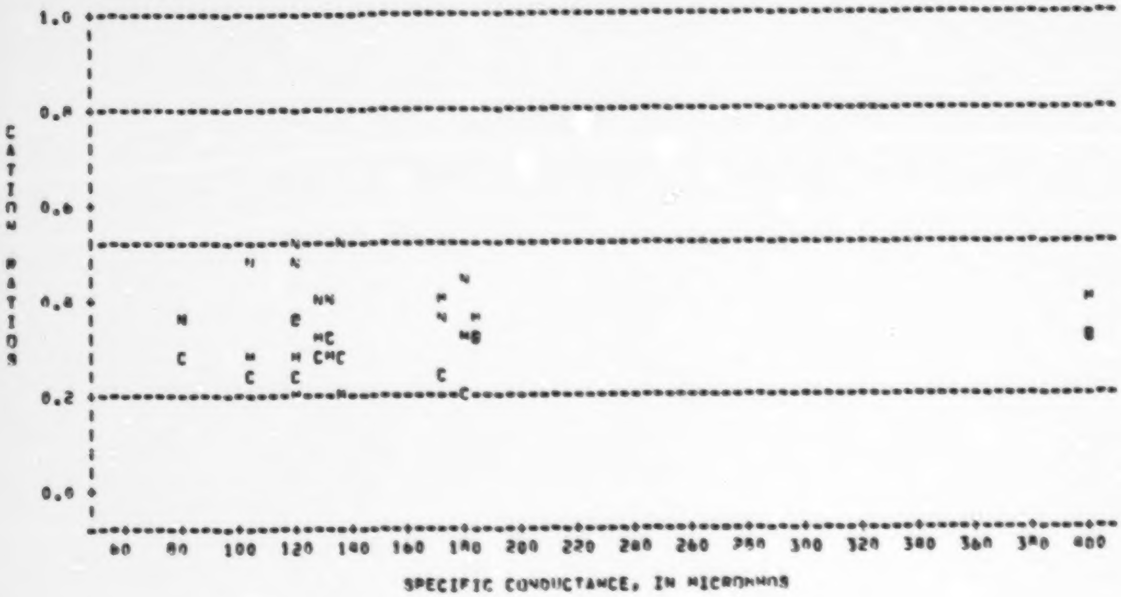

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ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO,  C IS CHLORIDE ION RATIO,  S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BRAZIL CREEK NR PANAMA, OK
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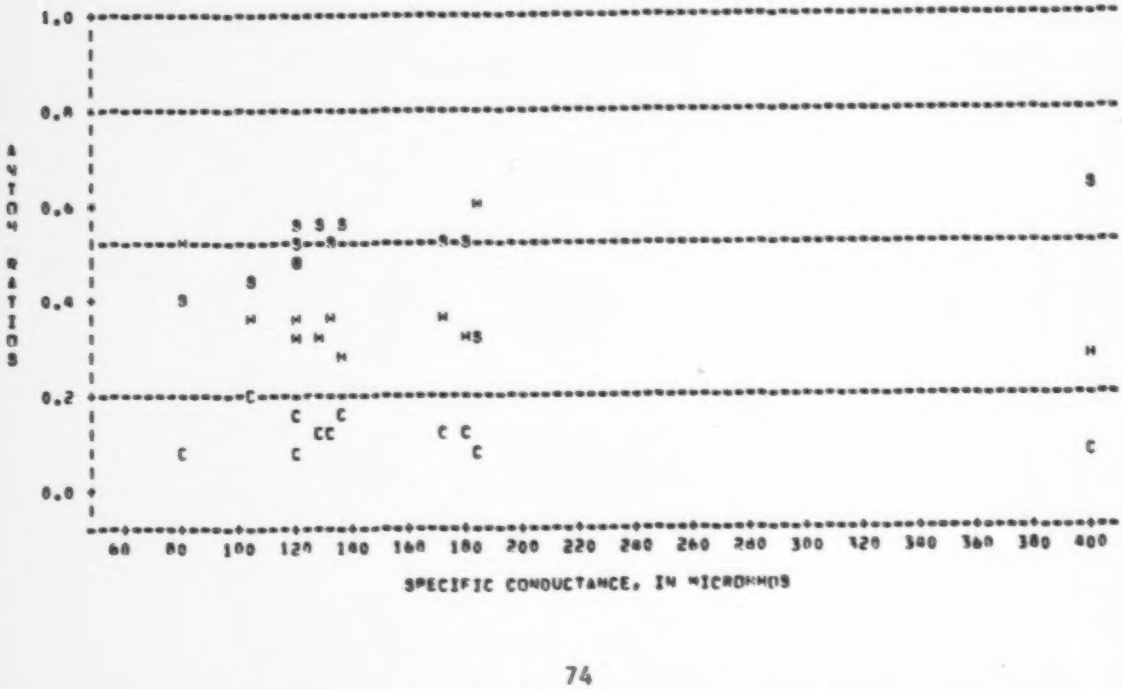

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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,  C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=BRAZIL CREEK NR PANAMA, OK
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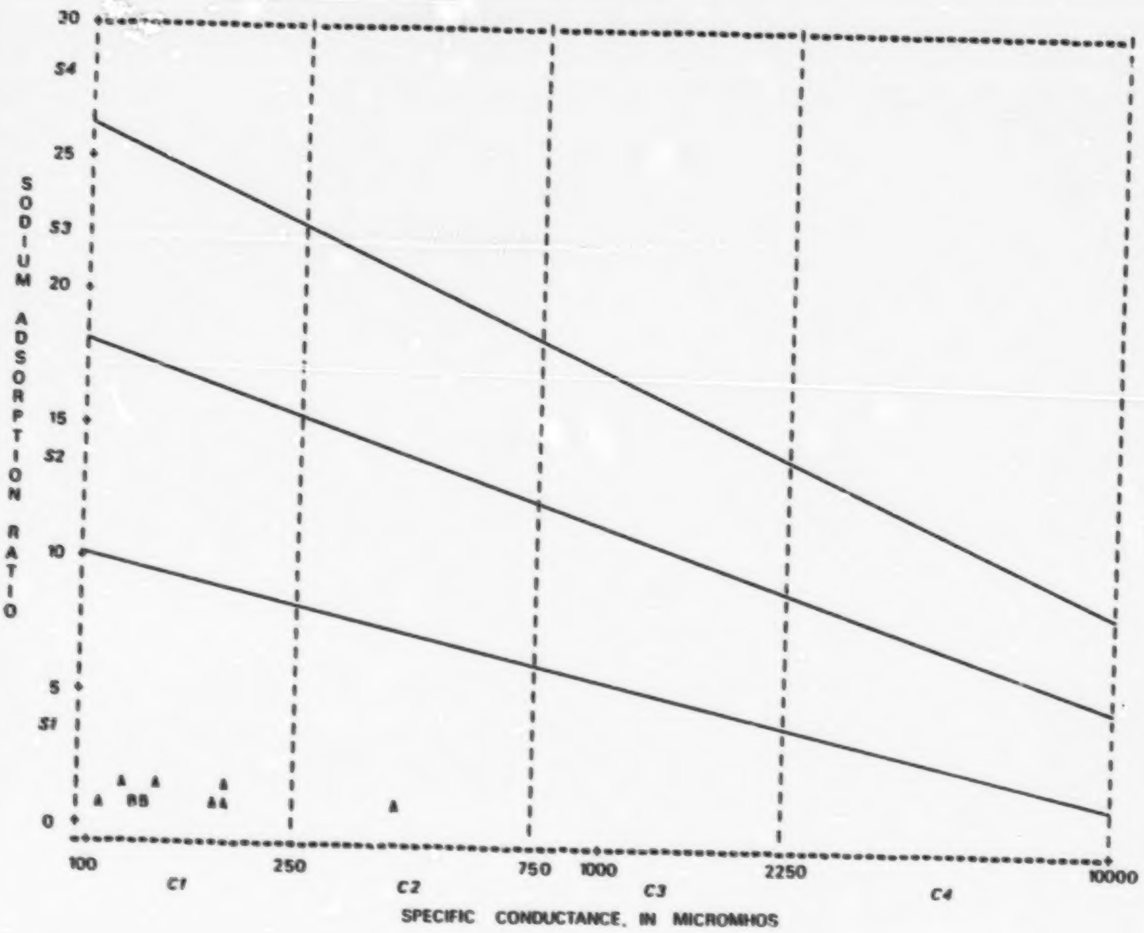


ARKANSAS RIVER MAINSTEM

07246600 - Cache Creek near Cowlington, Okla.

LOCATION.--Lat 35°17'10", long 94°45'35", in NE¼NE¼ sec.4, T.9 N., R.24 E., LeFlore County, at bridge on U.S. Highway 59, 2 mi southeast of Cowlington.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1959 to 1961.

WATER TYPE.--The water was generally mixed type with no ion ratio greater than 50 percent. For specific conductances greater than 200 umhos, which occurred in 28 percent of the samples, the water was sulfate type with the sulfate ion ratio 60 to 70 percent.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 56 mg/L and the water was soft. Hardness was greater than 60 mg/L, upper limit for soft class, for 22 percent of the hardness values. None of the measured constituents exceeded their respective recommended maximum concentrations. No data were available for the toxic elements. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium, with about 75 percent of the samples in the low salinity hazard class. The sodium hazard was low for all SAR values. The data indicate that plants should not show any effects from boron phytotoxicity.

07246600 - Cache Creek near Cowlington, Okla.--Continued

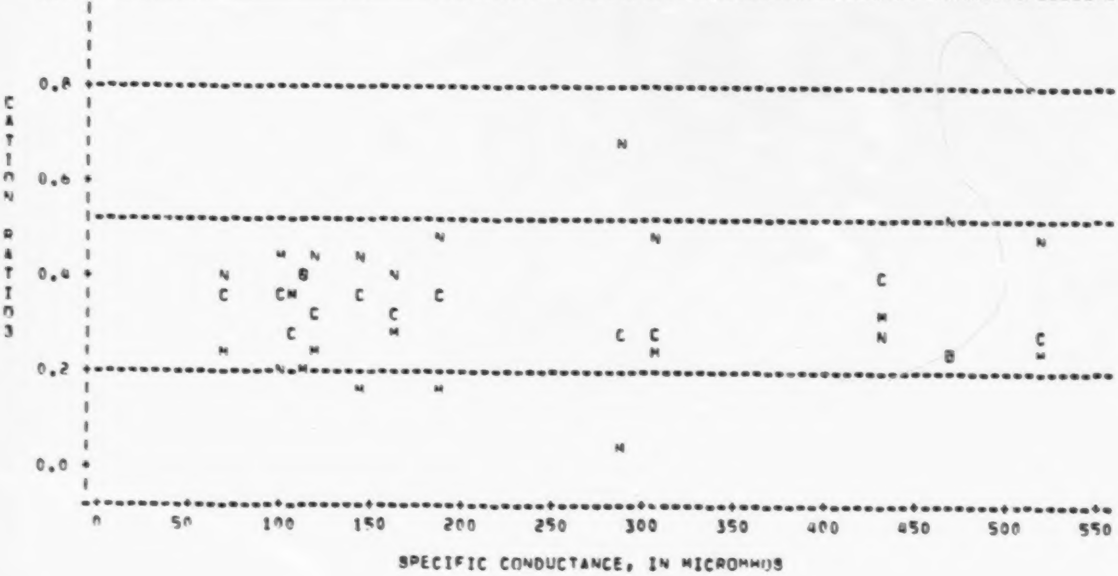
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	18	205	70	520	139	1.31	0.50
Dissolved solids	12	137	35	377	103	1.43	1.44
pH	18	7.6	7.0	8.2	0.4	-.17	-.16
Total hardness	18	56	18	164	40	1.87	2.95
Chloride	16	7.3	2.9	20	4.1	2.24	6.17
Sulfate	12	56	10	171	53	1.43	.97
Iron	0						
Fluoride	3	0.1	0.0	0.2			
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	13	1.2	0.3	2.8	0.7	1.01	.33
Boron	2	20	20	20			

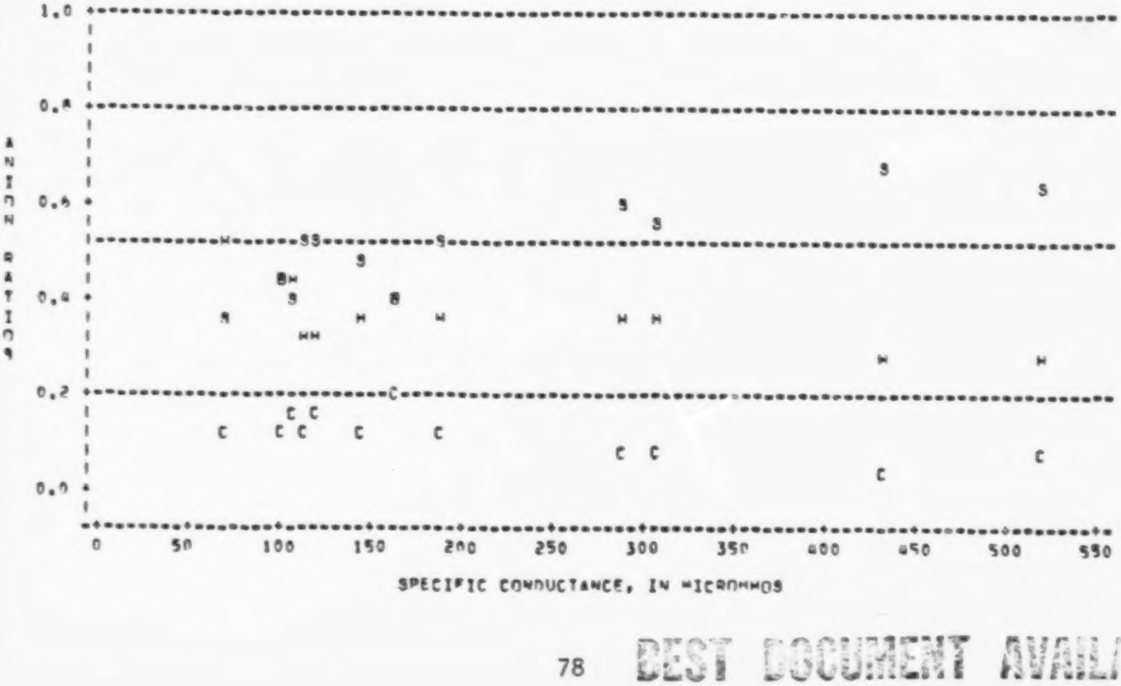
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	89	108	143	244	439
Dissolved solids	40	70	83	186	261
pH	7.0	7.4	7.6	7.8	8.0
Total hardness	21	30	42	54	102
Chloride	3.5	5.0	6.1	7.9	11
Sulfate	11	20	28	78	133
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.4	0.6	0.9	1.5	2.1
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=CACHE CREEK NR COWLINGTON, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=CACHE CREEK NR COWLINGTON, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD.   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD.  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=CACHE CREEK NR COWLINGTON, OK
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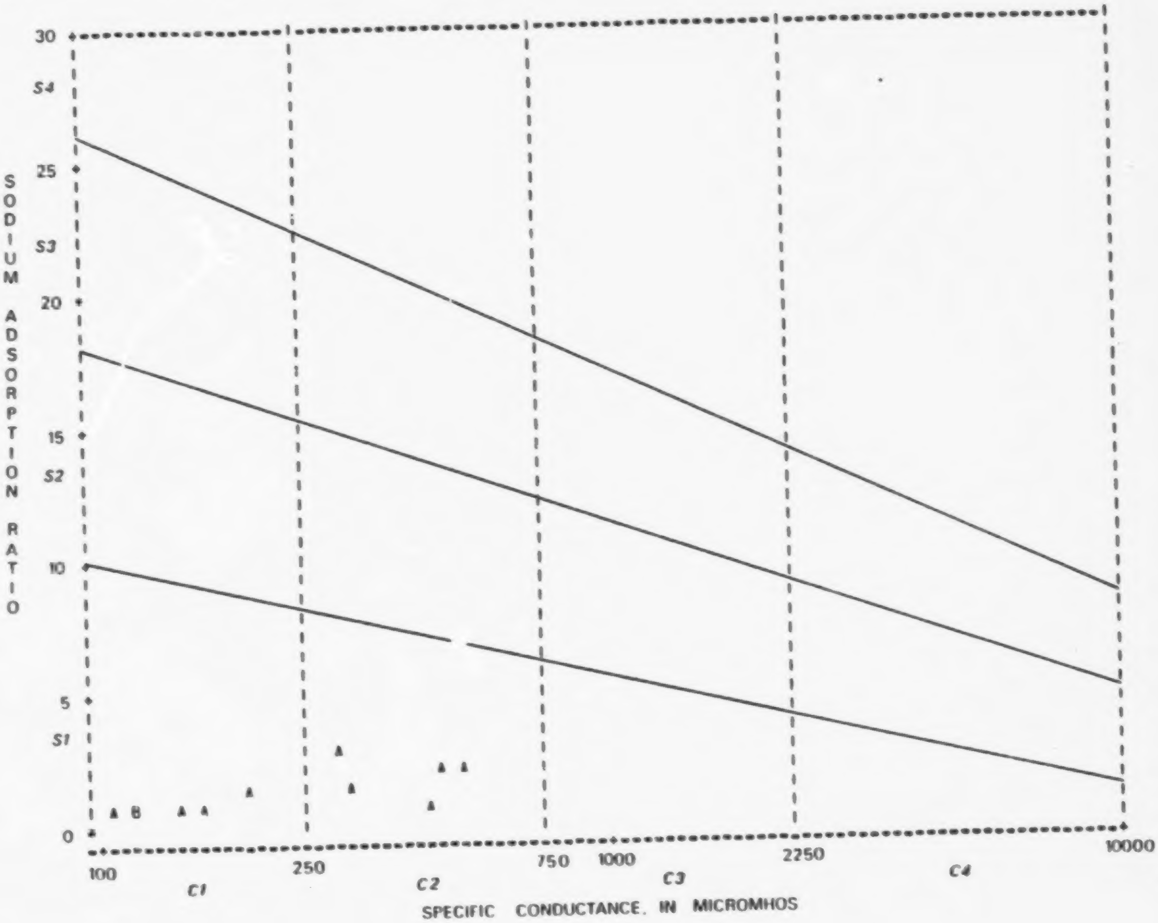


BEST DOCUMENT AVAILABLE

ARKANSAS RIVER MAINSTEM

07247500 - Fourche Maline near Red Oak, Okla.

LOCATION.--Lat 34°54'44", long 95°09'20", in NW¼NW¼ sec.13, T.5 N., R.20 E., Latimer County, 0.1 mi downstream from Little Fourche Maline, 5.0 mi southwest of Red Oak, and at mile 41.2.

DRAINAGE AREA.--122 mi^2.

PERIOD OF RECORD.--1952, 1954 to 1960, 1963, 1978.

WATER TYPE.--The available data were inadequate to fully describe the water type. The data show that for 96 percent of the samples, specific conductance of 300 umhos or less, the cations were mixed. In a single sample which had specific conductance of about 650 umhos, the magnesium ion was 60 percent of the major cations. Data for the anions were very sparse, and data plotted on the anion ratio plot is for specific conductances less than 50 umhos. Specific conductances less than 50 umhos accounted for only 12 percent of the samples; therefore, no analysis of the anion distribution was made.

TREND.--The current period of record was insufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 40 mg/L and the water was soft. Twenty percent of the hardness values were greater than 60 mg/L, and had a maximum of 90 mg/L which is within the moderately hard class. The minimum recommended pH of 5.0 was exceeded by 7 percent of the pH values and the maximum recommended pH of 9.0 was exceeded by 1 pH value. No data were available for the toxic elements. The pH extremes could adversely affect the suitability for use of the water for public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with about 92 percent of the samples having a low salinity hazard. The sodium hazard was low for all of the SAR values. No boron data were available.

07247500 - Fourche Maline near Red Oak, Okla.--Continued

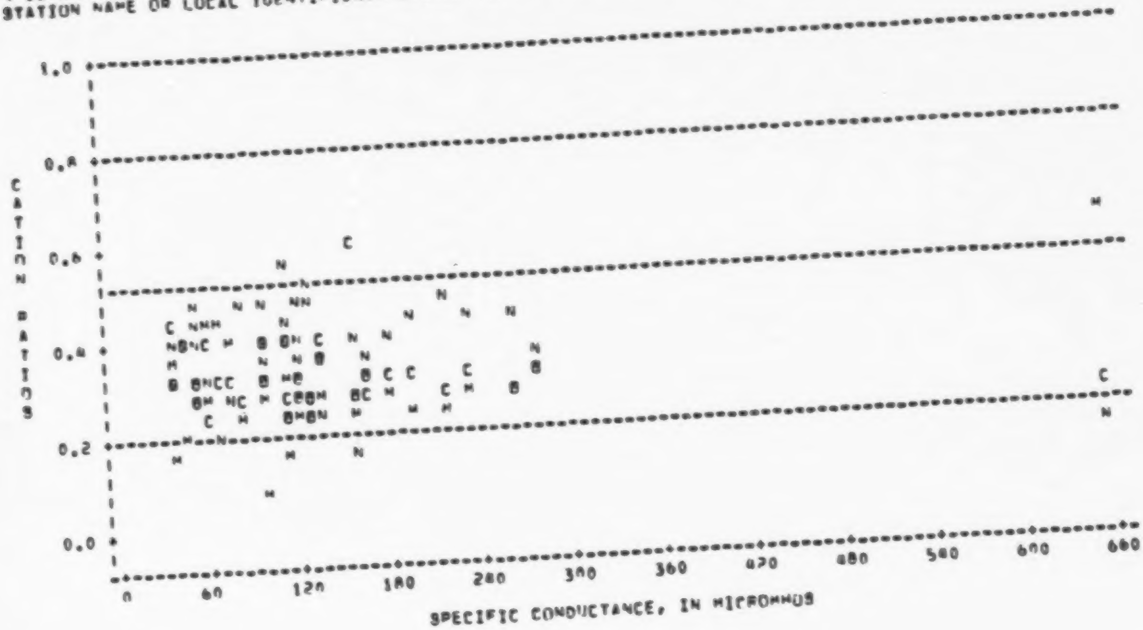
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	74	147	21	651	96	2.19	9.38
Dissolved solids	4	138	130	160			
pH	70	6.9	3.0	9.5	1.0	-1.63	5.07
Total hardness	61	40	8.0	90	21	.57	-.56
Chloride	16	7.0	0.0	18	3.9	.52	.22
Sulfate	13	23	10	58	14	1.78	2.89
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	38	0.8	0.2	1.4	0.3	.03	-.89
Boron	0						

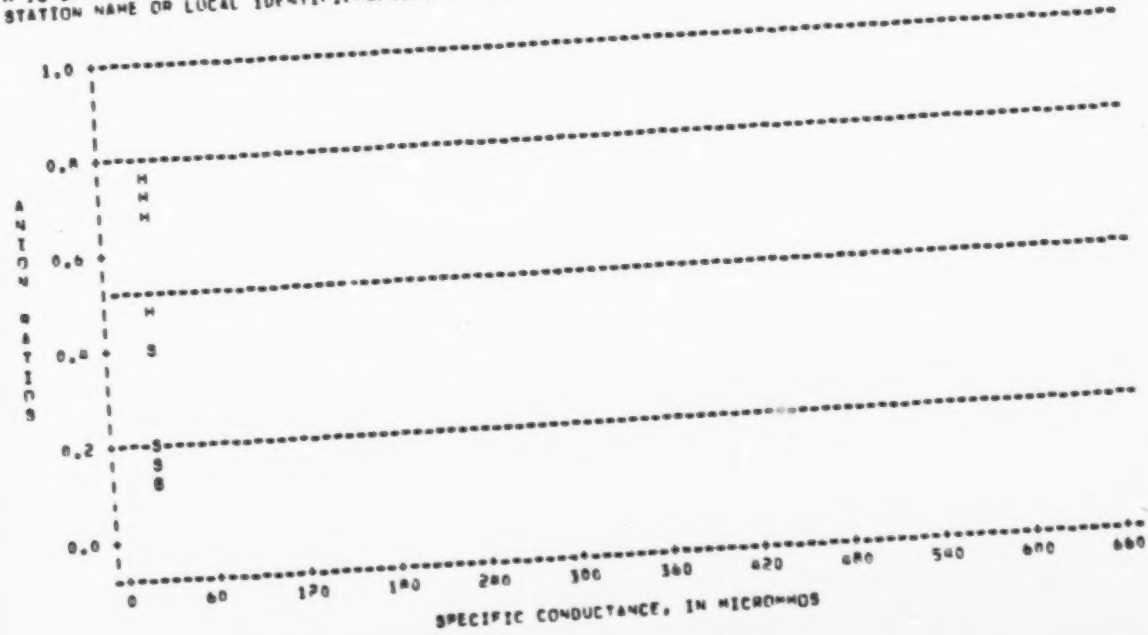
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	43	82	126	191	235
Dissolved solids					
pH	5.8	6.6	6.9	7.1	7.6
Total hardness	13	23	34	53	72
Chloride	1.8	3.6	7.0	8.8	12
Sulfate	10	11	19	23	39
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.3	0.4	0.7	1.0	1.2
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=FOURCHE MALINE RIVER NR RED OAK, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=FOURCHE MALINE RIVER NR RED OAK, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=FOURCHE MALINE RIVER NR RED OAK, OK
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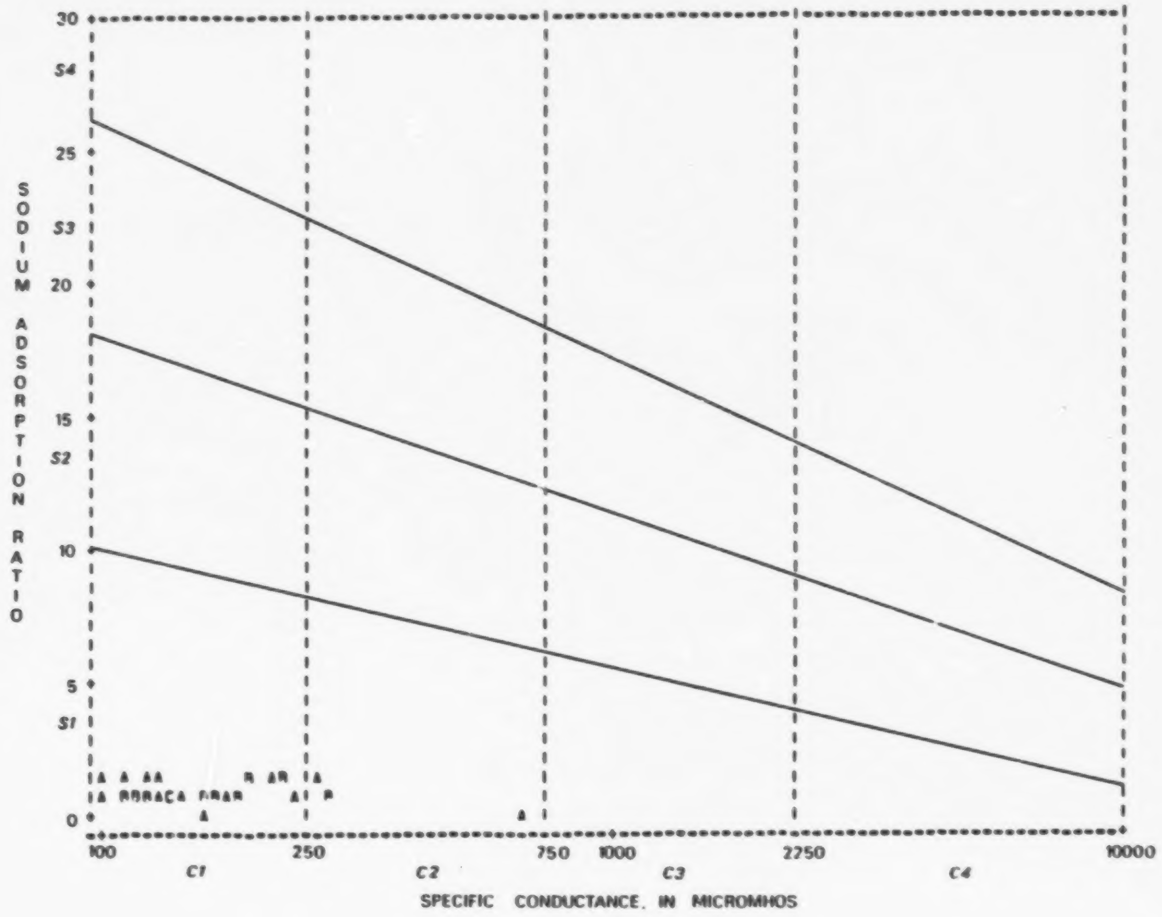


ARKANSAS RIVER MAINSTEM

07249400 - James Fork near Hackett, Ark.

LOCATION.--Lat 35°09'45", long 94°24'25", in NW¼NW¼ sec.34, T.6 N., R.32 W., Sebastian County, at bridge on State Highway 45, 1.7 mi south of Hackett, 2.0 mi downstream from Elder Branch, 2.0 mi upstream from small tributary, and 3.6 mi upstream from Arkansas-Oklahoma State line.

DRAINAGE AREA.--147 mi^2.

PERIOD OF RECORD.--1958 to 1978.

REMARKS.--Water-quality samples were collected by the Oklahoma District, U.S. Geological Survey from 1960 to 1961 and from 1969 to 1978. Water-quality samples have been collected by the Arkansas District, U.S. Geological Survey for the entire period of record.

WATER TYPE.--The water was sodium sulfate type in about 46 percent of the samples. The sulfate ion ratio was equal to or greater than 50 percent for approximately 95 percent of the samples. For specific conductances less than 300 umhos, which occurred in 53 percent of the samples, the water was mixed cation sulfate type.

TREND.--Plots of dissolved solids, hardness, chloride, and sulfate versus time did not indicate any trends. The data were insufficient to perform the Spearman's rho test for trend.

PUBLIC WATER SUPPLY.--The average hardness of the water was 100 mg/L and was moderately hard. The hardness was less than or equal to 60 mg/L, soft water, for 31 percent of the hardness values and 13 percent of the hardness values were equal to or greater than 180 mg/L, very hard water. The recommended maximum sulfate concentration of 250 mg/L was exceeded by 5 percent of the sulfate values and the recommended maximum iron concentration of 300 ug/L was exceeded by about 10 percent of the iron values. None of the maximum contaminant levels for the toxic metals were exceeded. Based on the data, this water would probably be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with 43 percent of the samples in the low salinity hazard class. The sodium hazard was low for all SAR values. Boron concentrations were small enough that no plant toxicity effects should occur.

07249400 - James Fork near Hackett, Ark.--Continued

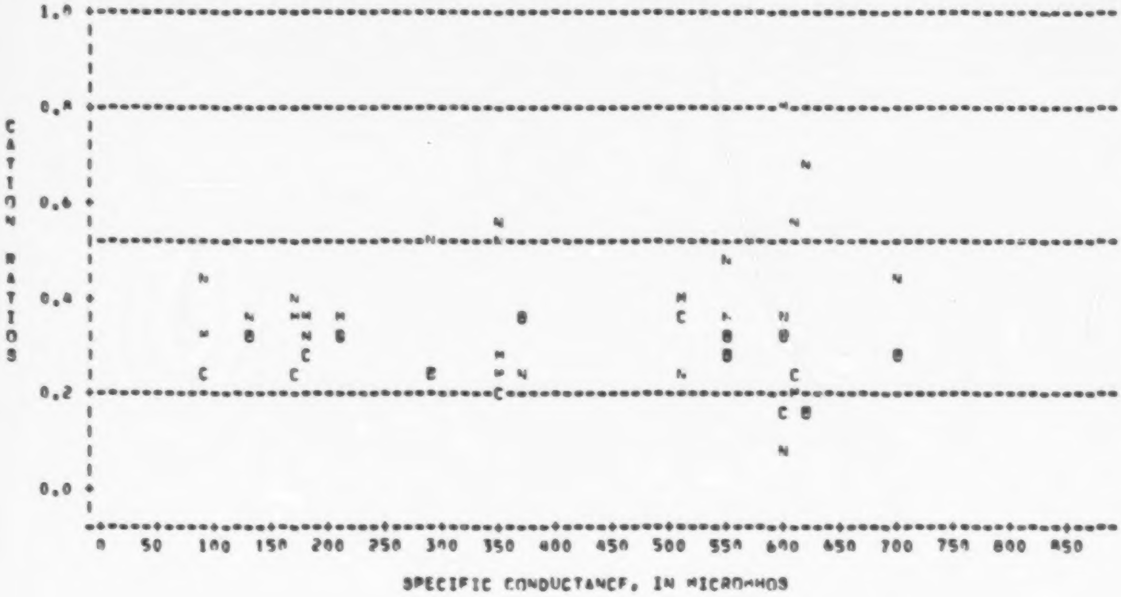
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	143	329	36	925	193	0.81	-0.05
Dissolved solids	34	282	79	570	143	.13	-1.21
pH	138	7.3	6.0	9.1	0.5	.21	1.50
Total hardness	53	100	23	230	57	.73	-.63
Chloride	101	9.0	3.0	39	4.9	3.33	16.26
Sulfate	70	101	5.0	290	63	1.82	3.39
Iron	39	116	0	590	120	2.07	4.95
Fluoride	15	0.2	0.1	0.3	0.1	.27	-1.50
Arsenic	41	0	0	2	0.9	1.89	2.98
Cadmium	39	1	0	5	0.8	2.39	8.43
Chromium	39	3	0	14	4.1	1.30	0.00
Lead	39	11	0	23	3.7	5.82	35.00
Mercury	41	0.1	0.0	0.8	0.1	4.38	22.30
SAR	25	1.6	0.4	4.4	0.9	1.53	3.22
Boron	34	48	0	110	24	.34	.28

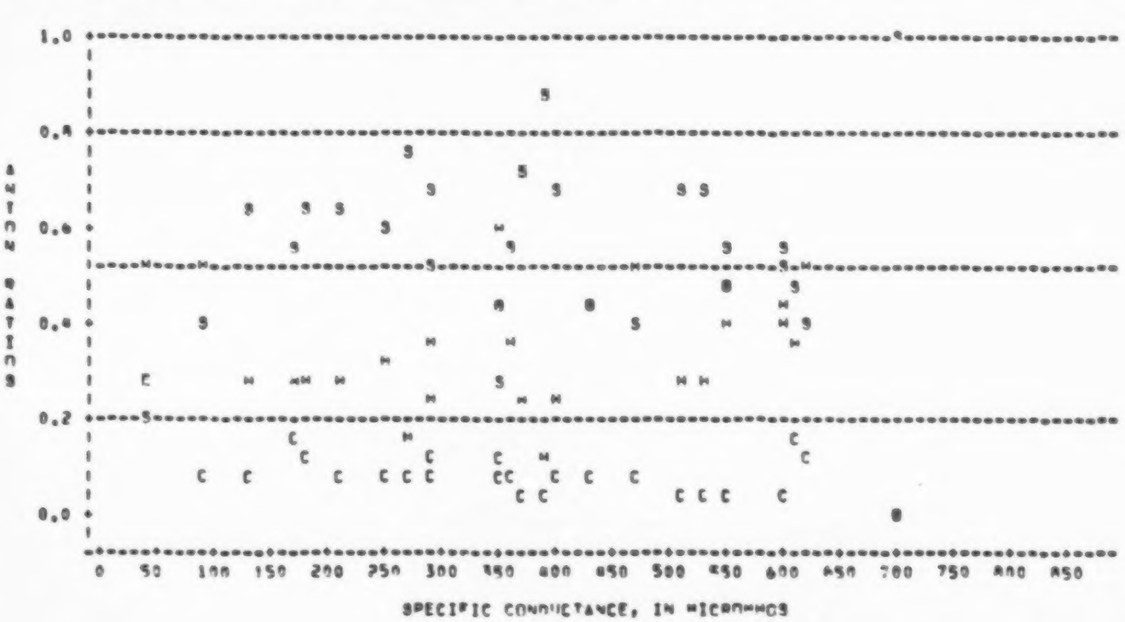
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	121	170	288	426	619
Dissolved solids	92	139	261	390	441
pH	6.7	7.1	7.3	7.6	7.8
Total hardness	36	53	81	140	188
Chloride	4.7	6.0	7.9	9.9	12
Sulfate	35	54	93	35	180
Iron	19	30	60	152	265
Fluoride	0.1	0.1	0.2	0.2	0.3
Arsenic	0	0	0	0	1
Cadmium	0	0	0	1	1
Chromium	0	0	0	2	10
Lead	0	1	4	6	10
Mercury	0.0	0.0	0.0	0.0	0.1
SAR	0.6	0.7	1.0	1.9	2.2
Boron	20	28	50	60	69

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=JAMES FORK NEAR HACKETT, ARK.



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=JAMES FORK NEAR HACKETT, ARK.



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=JAMES FORK NEAR HACKETT, ARK.
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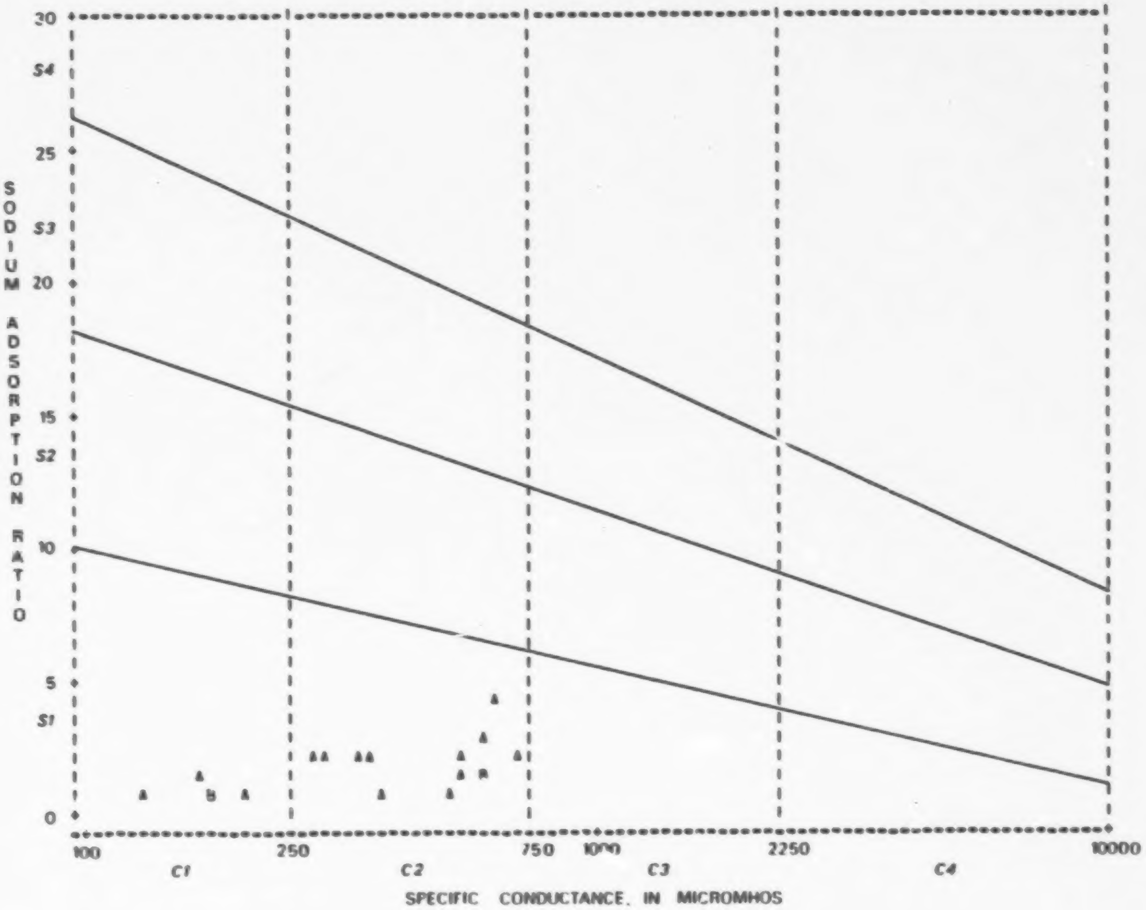


07249410 - James Fork near Williams, Okla.

LOCATION.--Lat 35°09'30", long 96°36'01", in NE¼NW¼ sec.21, T.8 N., R.26 E., LeFlore County, near county road 1.1 mi southwest of Williams.

DRAINAGE AREA.--198 mi^2.

PERIOD OF RECORD.--1976 to 1978.

WATER TYPE.--The water was sulfate type with no predominant cation. The sulfate ion ratio was equal to or greater than 50 percent for 82 percent of the samples.

TREND.--The period of record was insufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 122 mg/L, however, the water was moderately hard. More than 55 percent of the hardness values were less than 120 mg/L, the upper limit for the moderately hard class. For about 23 percent of the hardness values the concentration was greater than 180 mg/L, very hard class. In general, hardness at this location was moderately hard to hard with occasional periods of very hard water. The recommended maximum iron concentration of 300 ug/L was exceeded by 5 percent of the iron values. The maximum contaminant level for lead of 50 ug/L was exceeded by 1 of 38 values and the maximum contaminant level for mercury of 2 ug/L was exceeded by 1 of 40 values. Because of the exceedence of maximum contaminant levels by lead and mercury, this water may not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with 56 percent of the samples having a medium salinity hazard. The sodium hazard was low for all SAR values. Boron concentrations were small enough that phytotoxicity effects should not occur.

07249410 - James Fork near Williams, Okla.--Continued

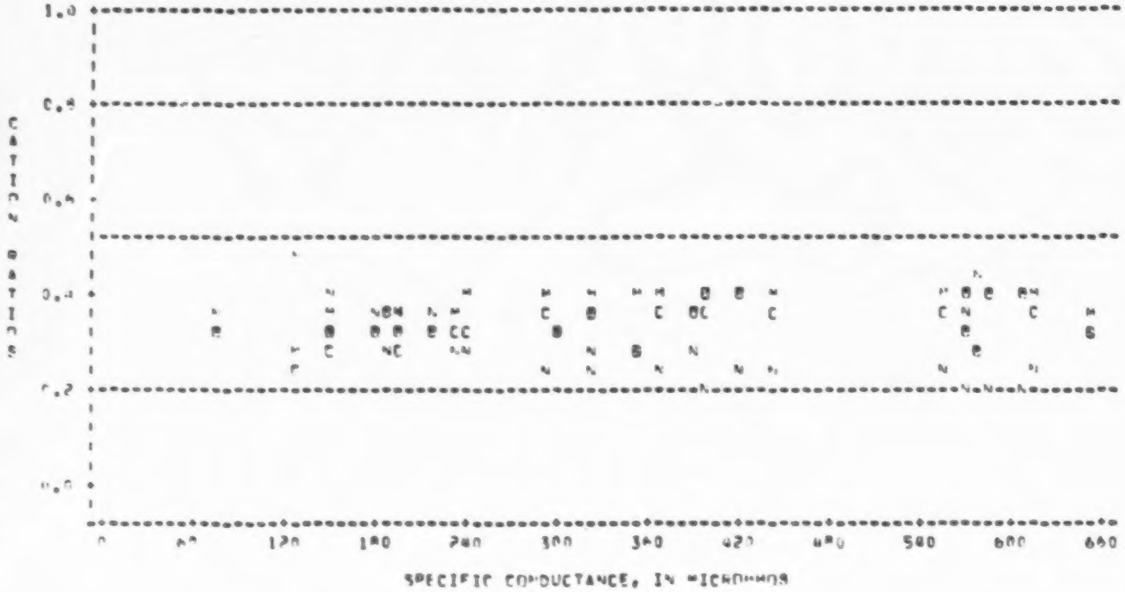
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	44	324	78	670	172	0.57	-0.87
Dissolved solids	33	216	69	406	106	.32	-1.25
pH	44	7.3	6.5	9.1	0.5	1.07	3.69
Total hardness	33	122	24	250	68	.29	-1.17
Chloride	33	7.0	3.6	12	1.9	.90	1.06
Sulfate	33	103	16	220	59	.37	-.97
Iron	38	127	10	490	104	1.61	3.04
Fluoride	33	0.2	0.0	0.3	0.1	.16	-.11
Arsenic	40	0	0	2	0.6	1.32	.86
Cadmium	38	1	0	10	1.9	2.89	10.81
Chromium	38	2	0	20	4.5	2.46	6.06
Lead	38	7	0	89	15	4.51	23.13
Mercury	40	0.6	0.0	23	3.6	6.31	39.90
SAR	33	0.8	0.4	2.1	0.3	2.92	10.33
Boron	37	41	20	80	16	.61	-.04

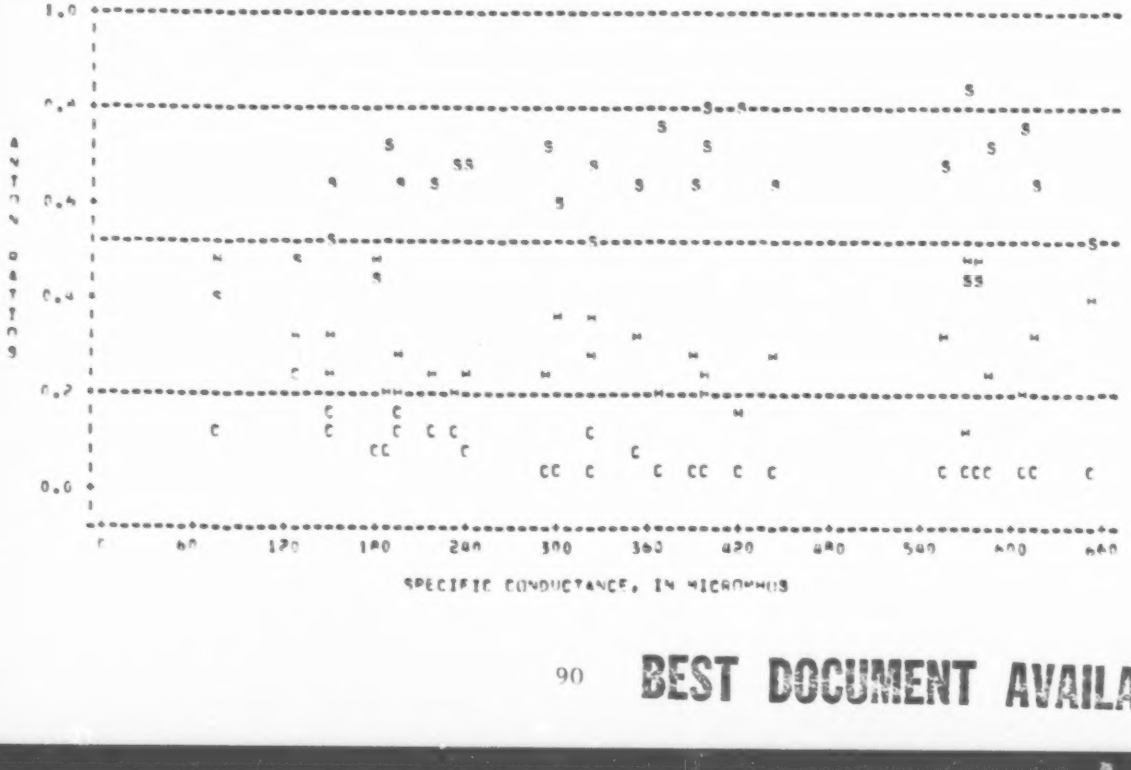
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	121	190	290	420	583
Dissolved solids	84	116	206	301	364
pH	6.7	7.1	7.3	7.6	7.8
Total hardness	35	58	112	167	217
Chloride	4.7	6.0	6.4	7.5	9.8
Sulfate	29	46	98	129	184
Iron	22	52	100	148	272
Fluoride	0.0	0.0	0.1	0.2	0.2
Arsenic	0	0	0	0	1
Cadmium	0	0	0	1	3
Chromium	0	0	0	0	7
Lead	0	1	2	7	11
Mercury	0.0	0.0	0.0	0.0	0.3
SAR	0.5	0.7	0.7	0.8	0.9
Boron	11	23	35	46	58

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=JAMES FORK NR WILLIAMS, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=JAMES FORK NR WILLIAMS, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=JAMES FORK NR WILLIAMS, OK
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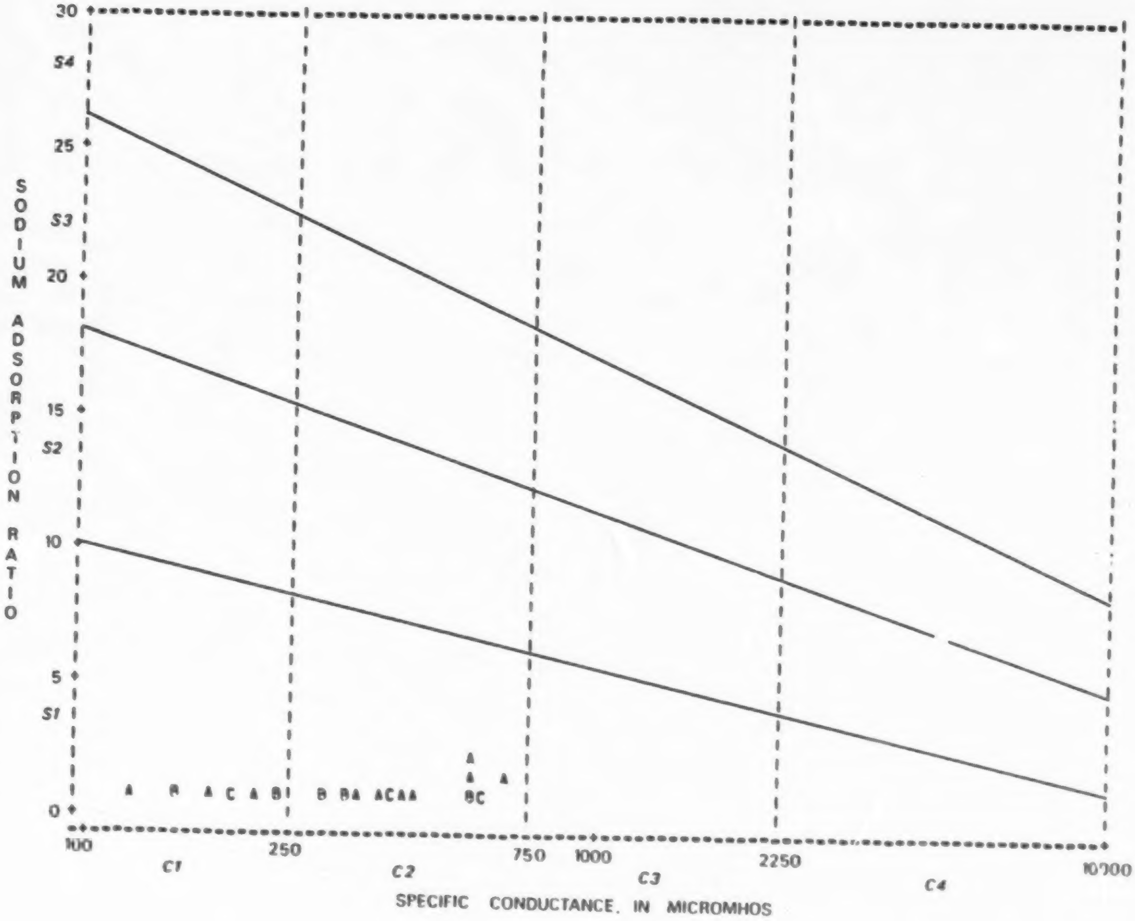


ARKANSAS RIVER MAINSTEM

07249800 - Lee Creek near Short, Okla.

LOCATION.--Lat 35°33'45", long 94°32'00", at north edge sec.34, T.13 N., R.26 E., Sequoyah County, at bridge on State Highway 101, 0.2 mi upstream from Little Lee Creek, and 0.5 mi west of Short.

DRAINAGE AREA.--236 mi^2.

PERIOD OF RECORD.--1958 to 1961, 1976 to 1977.

WATER TYPE.--The water was primarily calcium bicarbonate type. As the specific conductance increased, the calcium and bicarbonate ions decreased and the sodium and chloride ions increased. The calcium and bicarbonate ion ratios were, in general, greater than 50 percent throughout the range of measured specific conductances.

TREND.--The current period of record was insufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 40 mg/L and the water was soft. Only 6 percent of the hardness values were greater than 60 mg/L, and were in the moderately hard class, less than 120 mg/L. None of the measured constituents exceeded their respective recommended maximum limits. No data were available for the toxic metals. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity and sodium hazards at this location were in the low class for all available data. No boron data were available.

07249800 - Lee Creek near Short, Okla.--Continued

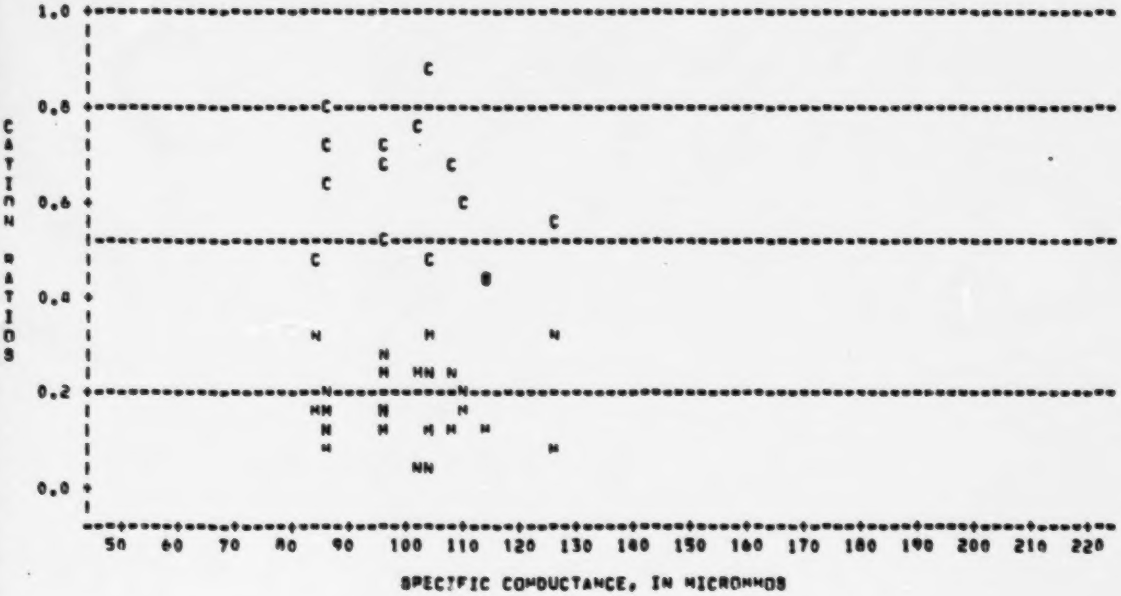
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	49	102	60	190	25	1.28	3.27
Dissolved solids	10	65	49	74	9	-.61	-1.08
pH	50	7.5	5.8	8.5	0.5	-.83	1.53
Total hardness	48	40	24	74	11	1.08	1.21
Chloride	45	8.6	2.3	32	7.0	1.84	2.96
Sulfate	24	10	1.6	58	14	2.83	7.73
Iron	0						
Fluoride	5	0.0	0.0	0.0			
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	16	0.4	0.0	1.0	0.3	1.02	1.13
Boron	0						

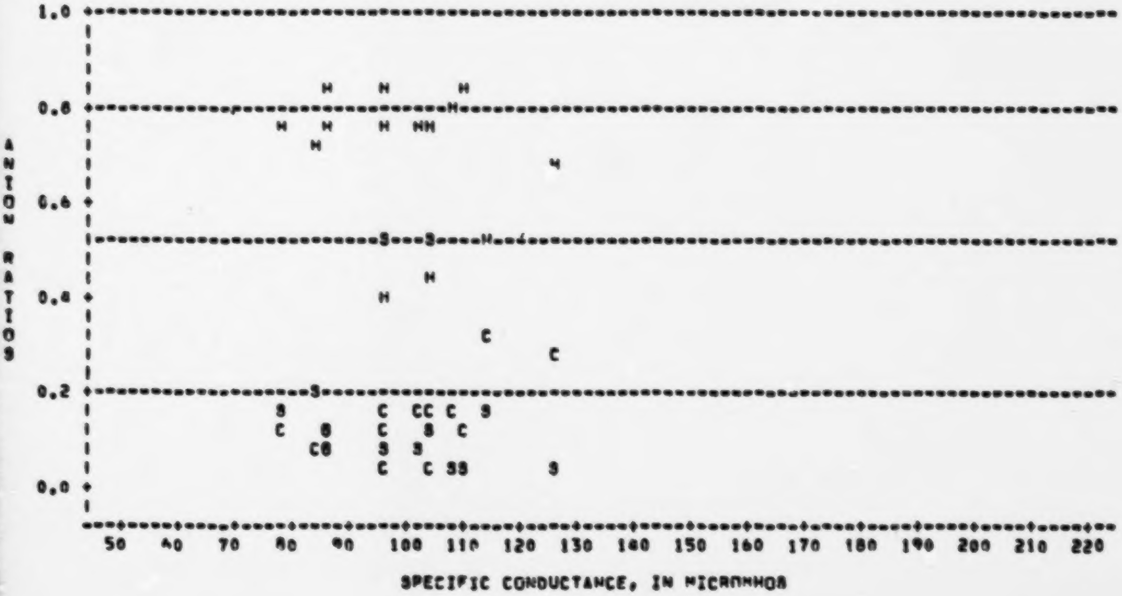
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	73	89	100	115	123
Dissolved solids	49	56	67	72	73
pH	6.8	7.2	7.5	7.8	7.9
Total hardness	29	32	38	44	53
Chloride	2.9	3.9	5.9	10	18
Sulfate	2.3	3.7	5.0	10	15
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.0	0.2	0.4	0.5	0.7
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=LEE CREEK NR SHORT, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=LEE CREEK NR SHORT, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=LEE CREEK NR SHORT, OK
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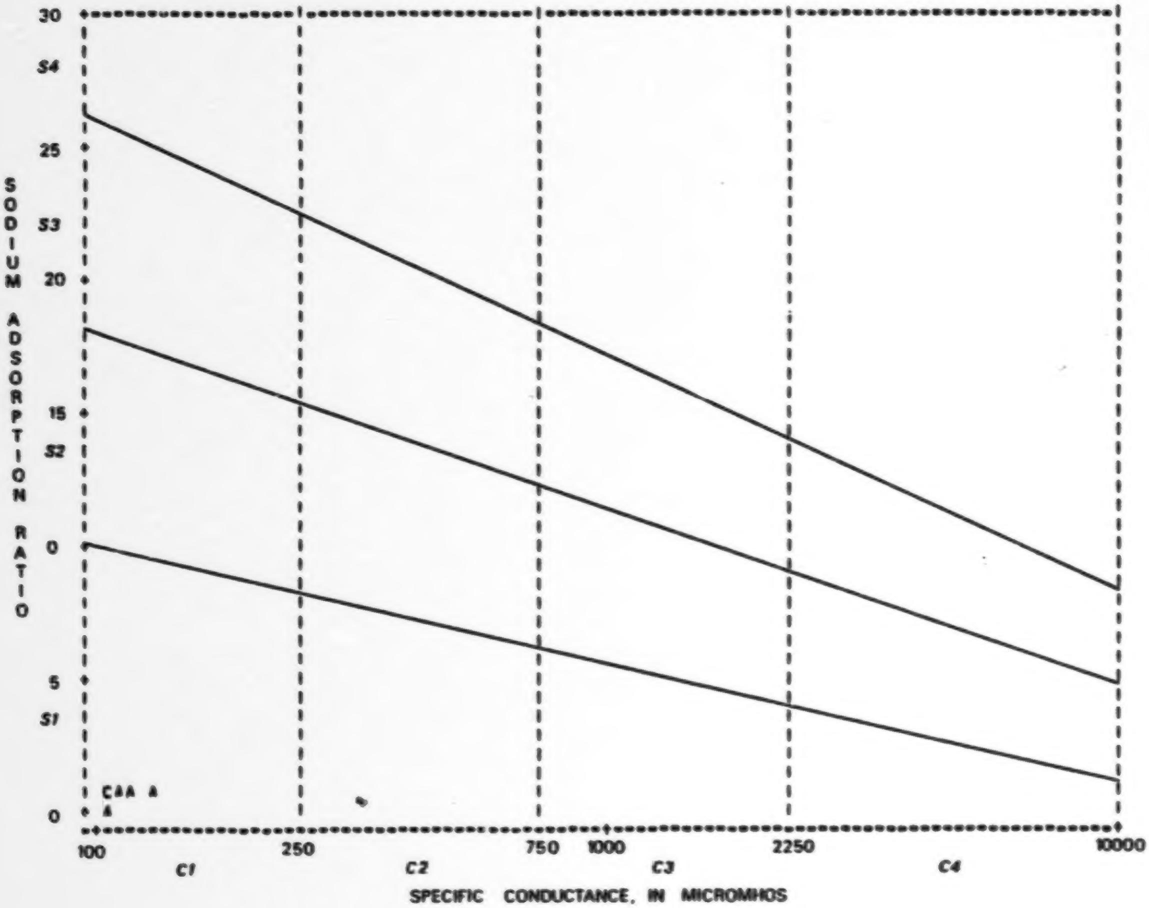


BEST DOCUMENT AVAILABLE

07165500 - Polecat Creek below Heyburn Reservoir, near Heyburn, Okla.

LOCATION.--Lat 35°56'42", long 96°17'39", in NW¼NW¼ sec.19, T.17 N., R.10 E., Creek County, on right bank of outlet channel, 1,100 ft downstream from Heyburn dam, 3.2 mi upstream from bridge on U.S. Highway 66, 11 mi southwest of Sapulpa, and at mile 48.4.

DRAINAGE AREA.--123 mi^2.

PERIOD OF RECORD.--1952 to 1953, 1956 to 1958, 1961.

WATER TYPE.--The water was sodium chloride type. Over the range of measured specific conductances, with few exceptions, the predominant anion was chloride and the predominant cation was sodium.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 82 mg/L and the water was moderately hard. Less than 4 percent of the hardness values were greater than 120 mg/L, hard class, and 25 percent of the hardness values less than 60 mg/L, soft class. No toxic element data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with more than 80 percent of the samples having medium salinity hazard. The sodium hazard was low for all SAR values. No boron data were available.

07165500 - Polecat Creek below Heyburn Reservoir, near Heyburn, Okla.--Continued

UNIVARIATE STATISTICS

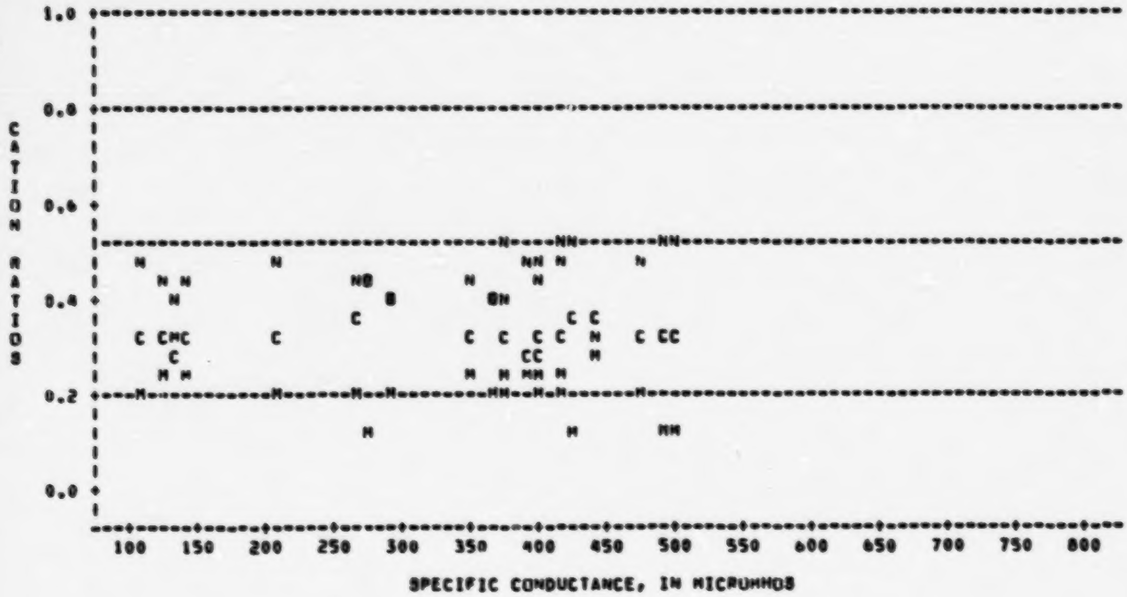
CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	31	366	110	787	142	0.29	1.51
Dissolved solids	3	173	122	207			
pH	26	7.1	6.1	8.0	0.5	-.15	-.76
Total hardness	26	82	26	136	29	-.48	-.52
Chloride	26	66	21	110	25	-.27	-.69
Sulfate	3	12	9.0	17			
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	26	1.5	0.9	2.4	0.5	0.47	-.73
Boron	0						

FREQUENCY DISTRIBUTION

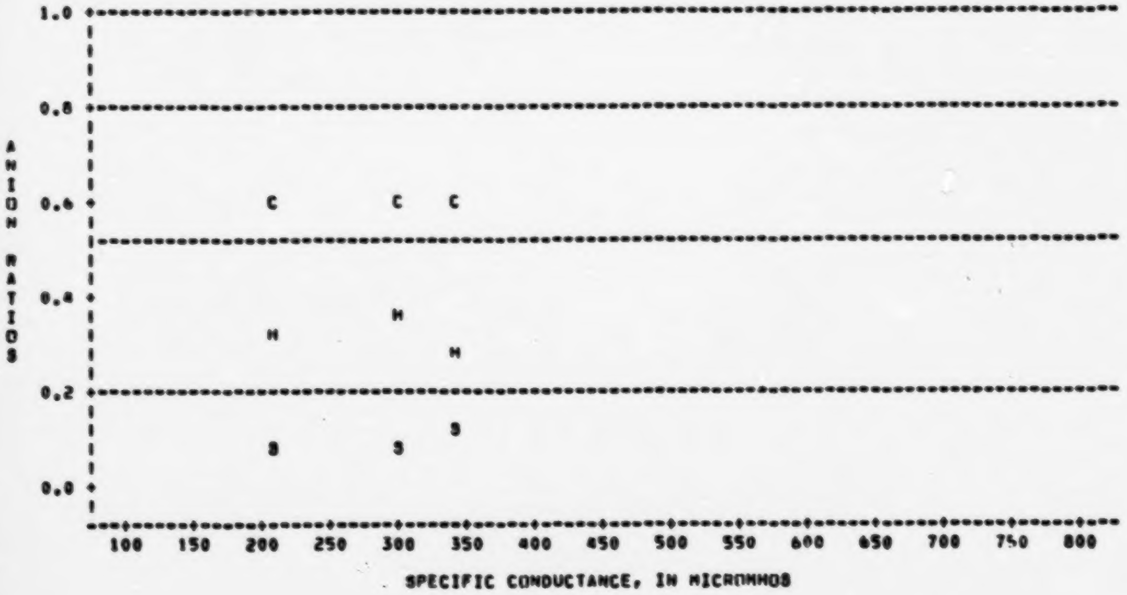
CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	135	275	387	445	488
Dissolved solids					
pH	6.3	6.5	7.1	7.5	7.7
Total hardness	33	60	92	98	112
Chloride	24	44	66	84	93
Sulfate					
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.6	1.1	1.4	1.8	2.1
Boron					

BEST DOCUMENT AVAILABLE

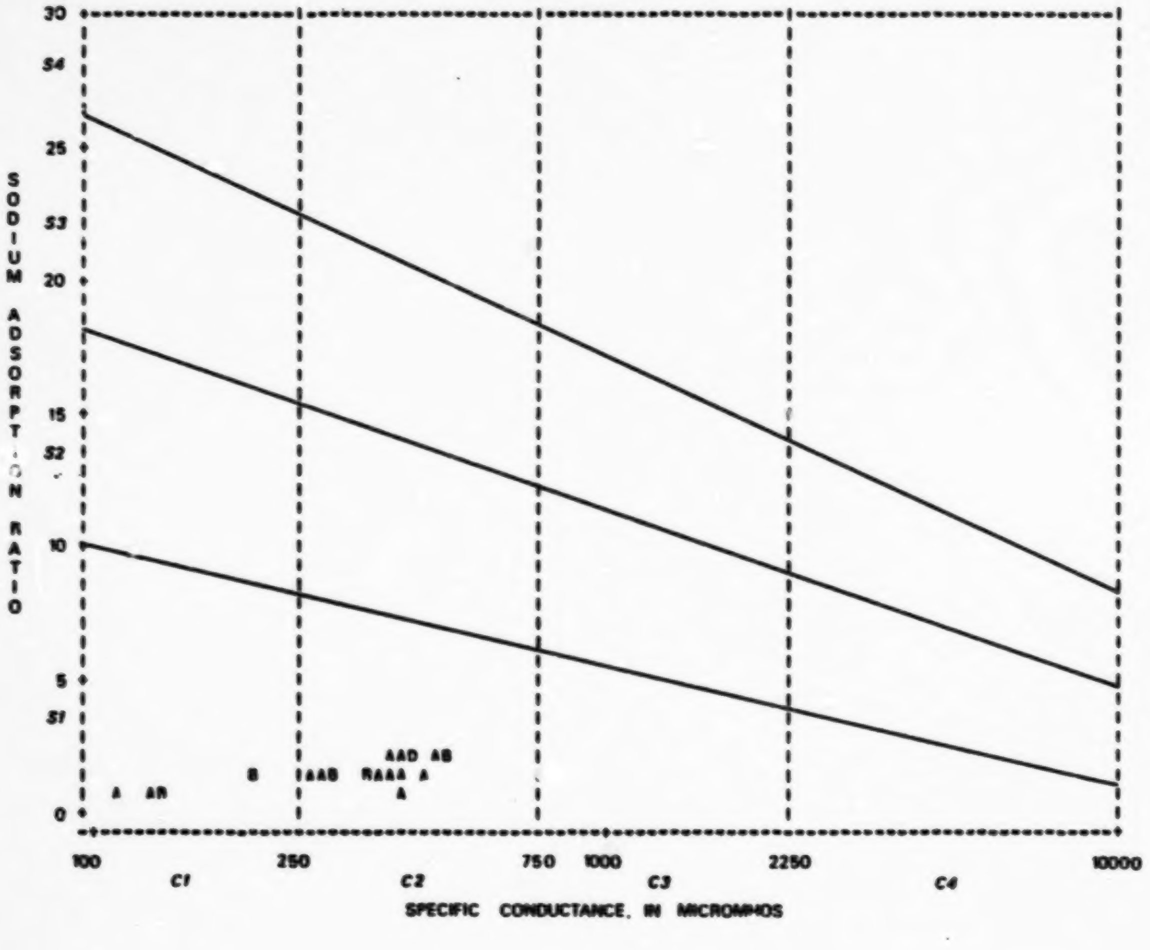
CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=POLECAT CREEK BLW HEYBURN RES NEAR HEYBURN, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=POLECAT CREEK BLW HEYBURN RES NEAR HEYBURN, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=POLECAT CREEK BLW HEYBURN RES NEAR HEYBURN, OK



07165510 - Polecat Creek near Jenks, Okla.

LOCATION.--Lat 36°00'57", long 96°00'41", in NE¼NE¼ sec.27, T.18 N., R.12 E., Tulsa County, at bridge on U.S. Highway 169, 2.5 mi west of Jenks.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1960 to 1963.

WATER TYPE.--The water was sodium chloride type. The anion, chloride made up more than 60 percent of the anions at all measured specific conductances and the cation sodium, with few exceptions, made up 50 percent or more of the cations.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 238 mg/L and the water was very hard. The hardness concentration was greater than 180 mg/L, very hard class, for 64 percent of the hardness values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 61 percent of the chloride values. No toxic element data were available. Because of the frequency of exceedence of the recommended maximum chloride concentration, this water may not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from medium to very high with 73 percent of the samples in the high or very high salinity hazard classes. The sodium hazard ranged from low to high with 54 percent of the SAR values having a low sodium hazard. No boron data were available.

07165510 - Polecat Creek near Jenks, Okla.--Continued

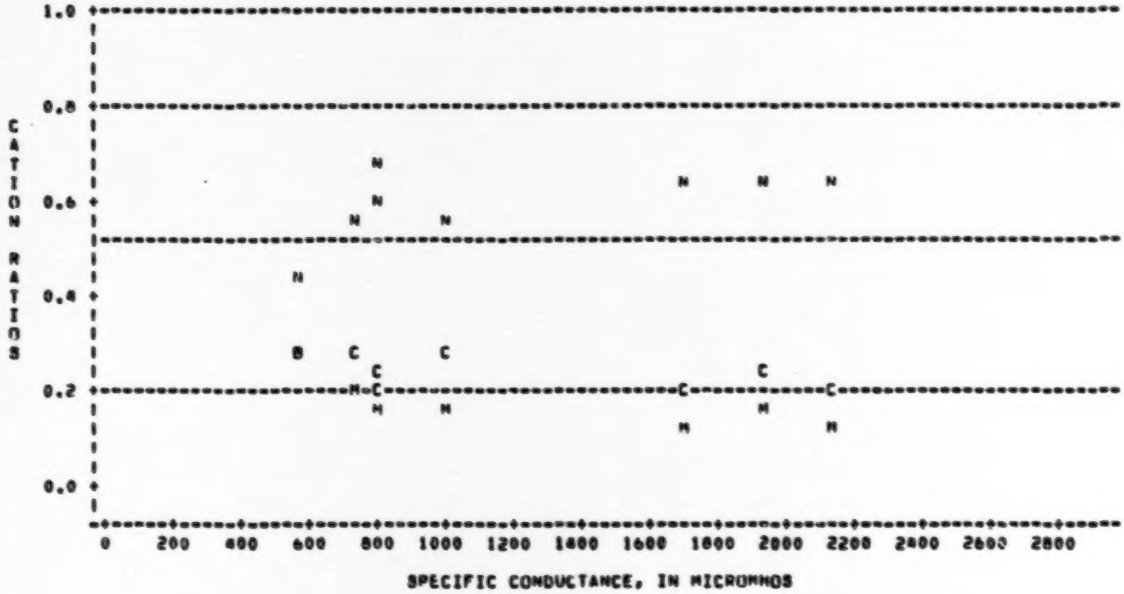
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	27	1409	275	2820	765	0.36	-.98
Dissolved solids	27	850	146	1740	466	.37	-.84
pH	27	8.0	7.1	8.4	0.4	-.89	.11
Total hardness	27	238	58	430	108	.19	-1.08
Chloride	27	377	59	850	231	.57	-.64
Sulfate	27	26	7.4	56	11	.85	1.11
Iron	0						
Fluoride	1	1.2					
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	27	5.0	1.3	9.3	2.2	.26	-.65
Boron	0						

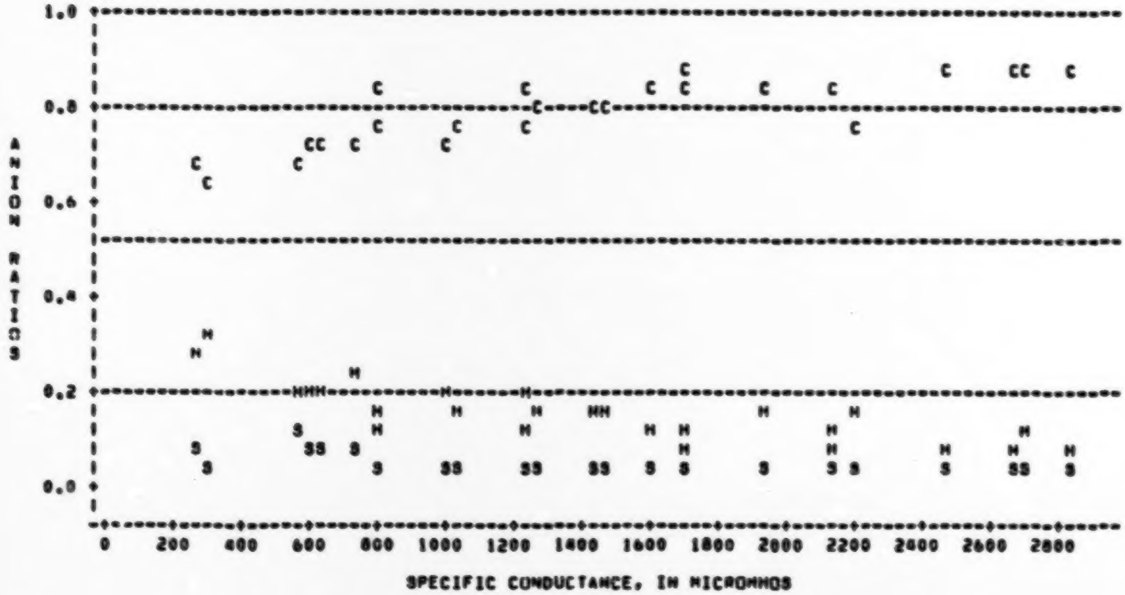
FREQUENCY DISTRIBUTION

	PERCENTILE CONCENTRATION				
CONSTITUENT	10th	25th	50th	75th	90th
Specific conductance	484	703	1250	1972	2534
Dissolved solids	289	435	791	1145	1526
pH	7.4	7.7	8.0	8.2	8.3
Total hardness	93	137	266	333	378
Chloride	104	161	335	482	740
Sulfate	8.1	19	23	30	39
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	1.9	3.0	4.6	6.1	8.1
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=POLECAT CREEK NR JENKS, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=POLECAT CREEK NR JENKS, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,    C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,   C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,   B = 2 OBS,   C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=POLECAT CREEK NR JENKS, OK
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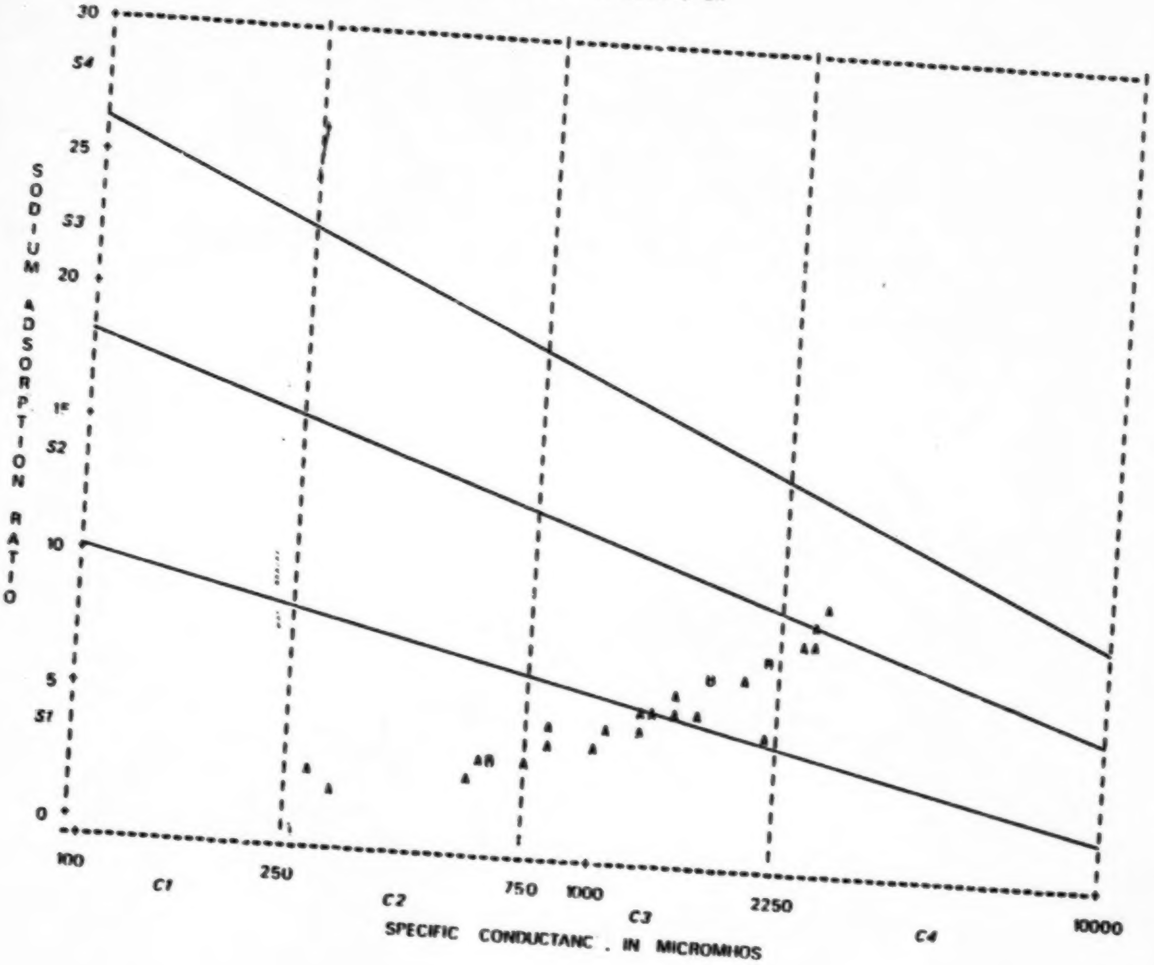

BEST DOCUMENT AVAILABLE

ARKANSAS RIVER MAINSTEM

07247000 - Poteau River at Cauthron, Ark.

LOCATION.--Lat 34°55'08", long 94°17'55", in NW¼SW¼ sec.16, T.3 N., R.31 W., Scott County, at highway bridge at Cauthron, 2.9 mi downstream from Cross Creek, 7.8 mi downstream from Jones Creek, and at mile 109.0.

DRAINAGE.--203 mi^2.

PERIOD OF RECORD.--1945 to 1961.

WATER TYPE.--The water was bicarbonate type. The sodium ratio was not equal to or greater than 50 percent in most of the samples, it was, however, greater than 40 percent. Therefore, the Poteau River at this location can be considered to be sodium bicarbonate type.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 19 mg/L and the water was soft. All hardness values were less than 60 mg/L, soft class. The recommended maximum iron concentration of 300 ug/L was exceeded by two of three iron values. The maximum contaminant levels for cadmium of 10 ug/L and for lead of 50 ug/L were each exceeded by 1 of 6 values. Because of the exceedence of maximum contaminant levels by cadmium and lead, the suitability of this water for public supply may be questionable.

IRRIGATION.--The salinity hazard ranged from low to high, with 99 percent of the samples having a low salinity hazard, specific conductance less than 250 umhos. The sodium hazard was low for all SAR values. Data indicate that boron phytoxicity effects should not occur.

07247000 - Poteau River at Cauthron, Ark.--Continued

UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	82	85	36	1525	163	8.77	78.47
Dissolved solids	57	51	26	96	15	1.11	1.34
pH	77	7.0	5.7	8.0	0.4	-0.22	-0.02
Total hardness	79	19	8.0	58	8.1	2.03	6.23
Chloride	77	3.9	1.2	13	2.1	2.04	5.10
Sulfate	72	7.6	2.0	30	4.4	2.38	9.13
Iron	3	347	130	470			
Fluoride	6	0.2	0.0	0.5			
Arsenic	6	2	0	4			
Cadmium	6	4	1	12			
Chromium	6	3	0	10			
Lead	6	41	3	130			
Mercury	6	0.2	0.0	0.9			
SAR	59	0.5	0.3	1.3	0.2	2.42	8.44
Boron	4	38	20	50			

FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	45	53	62	74	96
Dissolved solids	34	41	48	56	71
pH	6.4	6.7	7.0	7.4	7.5
Total hardness	11	13	17	22	28
Chloride	1.9	2.7	3.4	4.3	6.9
Sulfate	3.5	4.5	6.4	9.2	11
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.3	0.3	0.4	0.5	0.7
Boron					

```
CATION RATIO PLOT
N IS SODIUM ION RATIO,  C IS CALCIUM ION RATIO,  M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=POTEAU RIVER AT CAUTHRON, ARK.
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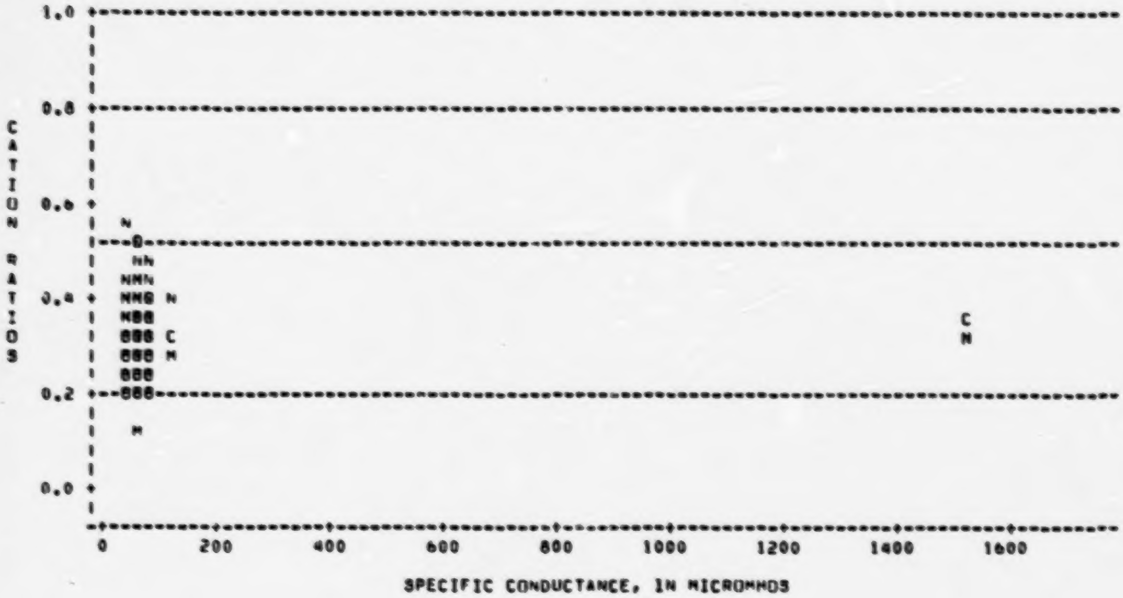

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ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO,  C IS CHLORIDE ION RATIO,  S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=POTEAU RIVER AT CAUTHRON, ARK.
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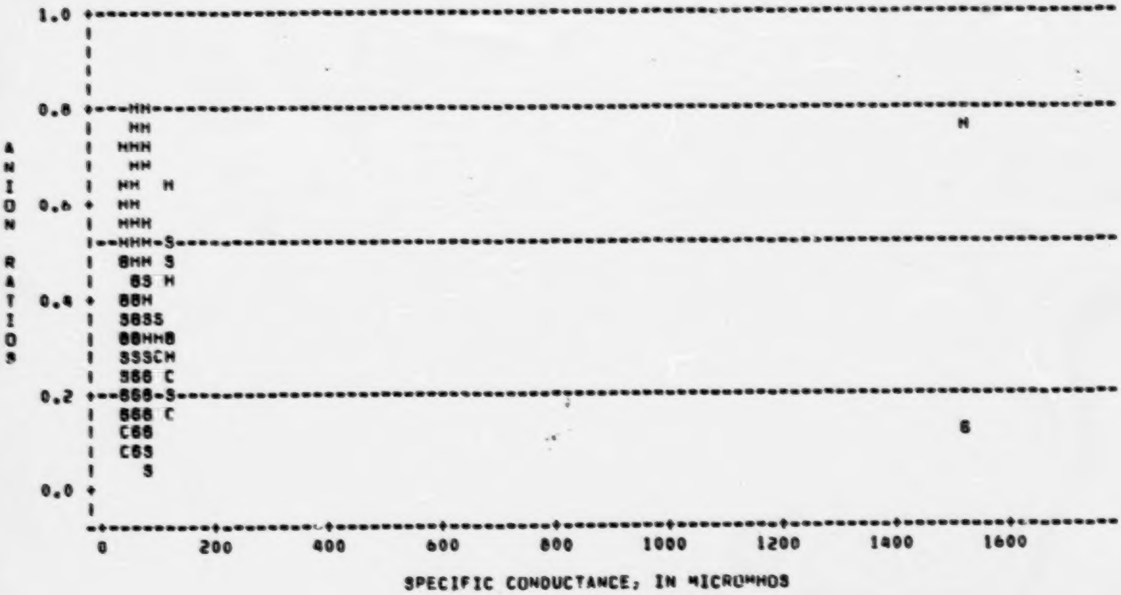
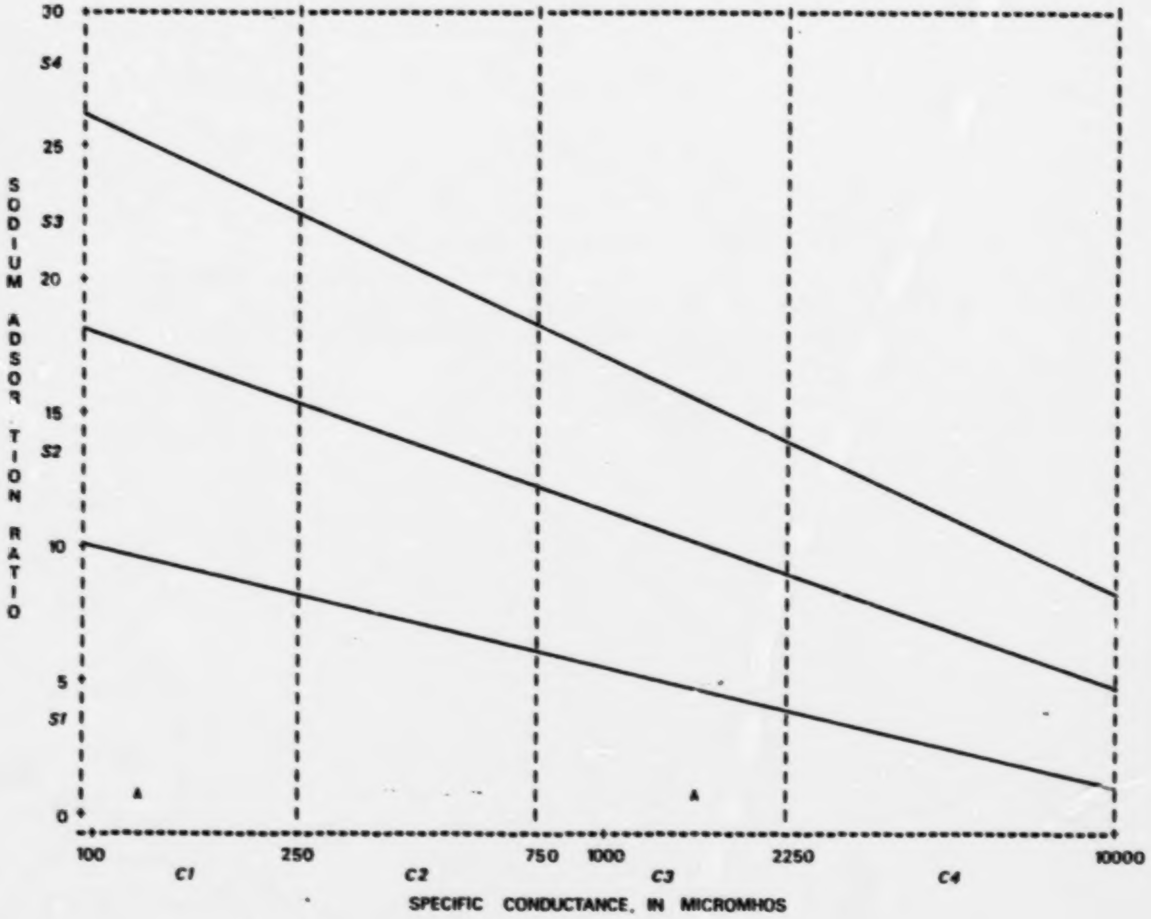


IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=POTEAU RIVER AT CAUTHRON, ARK.



BEST DOCUMENT AVAILABLE

07248500 - Poteau River near Wister, Okla.

LOCATION.--Lat 34°56'15", long 94°42'54", in NW¼NW¼ sec.6, T.5 N., R.25 E., LeFlore County, at bridge on U.S. Highway 270 downstream from Wister Dam, 2.2 mi southeast of Wister, 2.6 mi upstream from Caston Creek, and at mile 60.8.

DRAINAGE AREA.--993 mi^2.

PERIOD OF RECORD.--1948, 1952, 1955 to 1959, 1976 to 1978.

WATER TYPE.--The water was mixed type. No cation or anion were predominant.

TREND.--The current period of record was insufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 23 mg/L and the water was soft. For more than 99 percent of hardness values the concencentration was less than 60 mg/L, the upper limit for the soft class. The minimum recommended pH of 5.0 was exceeded by less than 2 percent of the pH values. No toxic element data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard and the sodium hazard were in the low class for all data. Boron concentrations were small enough so that plant phytotoxicity effects should not occur.

07248500 - Poteau River near Wister, Okla.--Continued

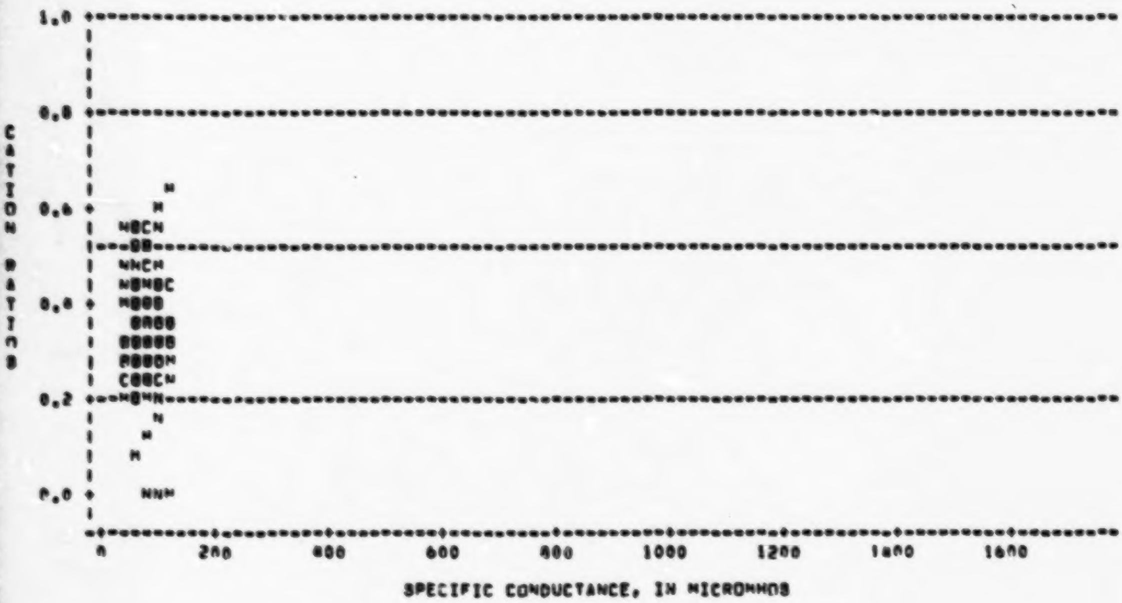
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	161	79	37	1150	88	11.35	183.21
Dissolved solids	124	57	11	108	18	-1.05	3.26
pH	123	6.8	3.7	9.4	0.7	-0.10	2.94
Total hardness	154	23	8.0	67	8.6	1.44	4.16
Chloride	158	5.1	1.0	20	2.7	2.17	7.52
Sulfate	148	12	0.0	45	6.6	2.37	9.64
Iron							
Fluoride	82	0.2	0.0	0.7	0.2	0.86	-0.20
Arsenic							
Cadmium							
Chromium							
Lead							
Mercury							
SAR	89	0.5	0.0	1.2	0.2	-0.15	1.81
Boron	60	65	0	310	69	1.55	3.07

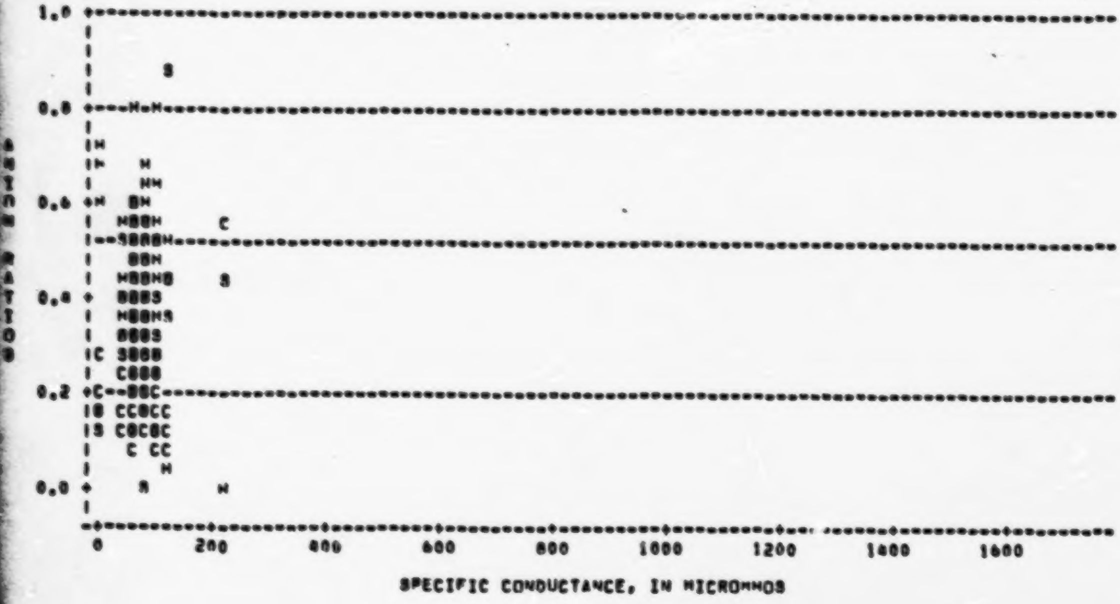
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	51	61	69	84	100
Dissolved solids	40	48	58	68	74
pH	6.0	6.4	6.7	7.2	7.8
Total hardness	14	16	21	27	34
Chloride	2.6	3.4	4.7	5.9	7.8
Sulfate	6.2	8.2	11	14	18
Iron					
Fluoride	0.0	0.1	0.1	0.4	0.5
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.0	0.4	0.4	0.6	0.6
Boron	0	0	50	100	140

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=POTEAU RIVER NR WISTER, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=POTEAU RIVER NR WISTER, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=POTEAU RIVER NR WISTER, OK
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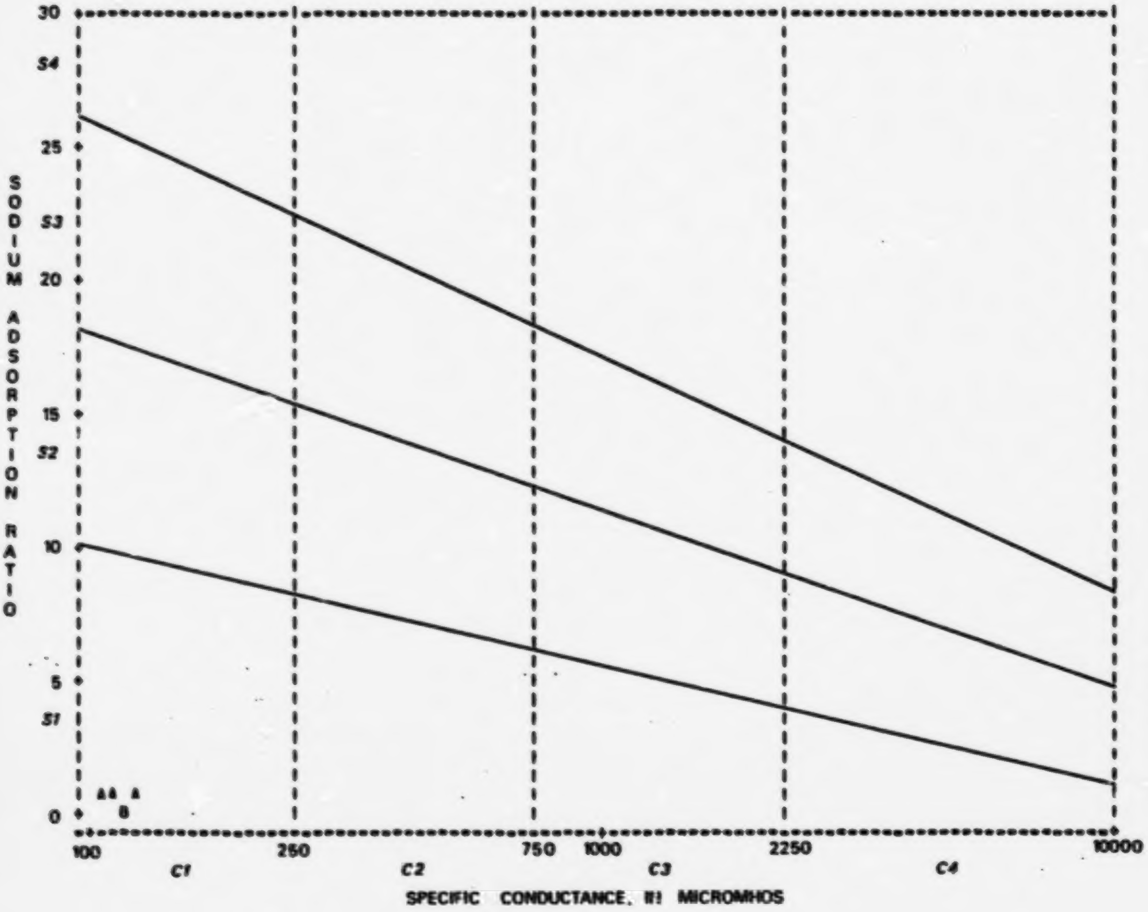


07152350 - Red Rock Creek near Red Rock, Okla.

LOCATION.--Lat 36°29'45", long 97°04'25", in SW¼SE¼ sec.3, T.23 N., R.2 E., Noble County, at bridge on State Highway 40, 6 mi east of Red Rock.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1951 to 1959, 1962 to 1963.

WATER TYPE.--For specific conductances less than or equal to 1,100 umhos, which occurred in 79 percent of the samples, the predominant anion was carbonate/bicarbonate. For specific conductances greater than 1,100 umhos, the chloride ratio increased while the carbonate/bicarbonate ratio decreased. For specific conductances greater than 400 umhos, which occurred in 66 percent of the samples, the cation sodium was predominant. For specific conductances of 400 umhos or less, calcium ion was predominant. In general, when the specific conductance was less than or equal to 400 umhos, the water was calcium carbonate/ bicarbonate type and when the specific conductance was greater than 1,100 umhos, the water was sodium chloride type. The water was mixed type for specific conductances between 400 and 1,100 umhos.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 204 mg/L and the water was very hard. More than 80 percent of the hardness values were greater than 120 mg/L, the lower limit of the hard class, and 67 percent of the hardness values were greater than 180 mg/L, very hard class. The recommended maximum chloride concentration of 250 mg/L was exceeded by 9 percent of the chloride values. No toxic element data were available. Based on the data, this water is probably suitable for use as a public supply. However, data indicate that chloride concentrations would be large enough at times to affect taste.

IRRIGATION.--The salinity hazard ranged from low to high with 62 percent of the samples having a high salinity hazard, specific conductance greater than 750 umhos. The sodium hazard ranged from low to medium, with approximately 93 percent of the SAR values having a low sodium hazard. No boron data were available.

UNIVARIATE STATISTICS

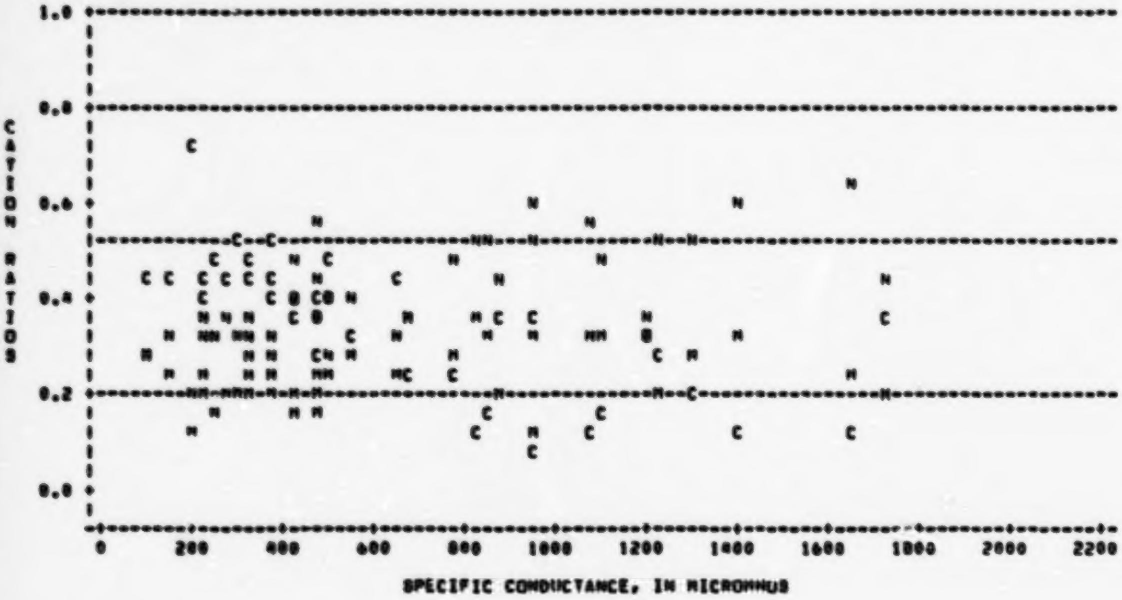
CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	81	741	93	2040	493	0.96	-0.05
Dissolved solids	26	562	177	1170	321	.62	-.84
pH	79	8.0	6.8	8.7	0.5	-.85	.27
Total hardness	81	204	34	564	125	1.26	1.19
Chloride	81	93	6.2	535	97	2.08	5.16
Sulfate	40	58	9.9	171	47	1.06	.15
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	56	2.4	0.4	7.1	1.6	0.98	0.21
Boron	0						

FREQUENCY DISTRIBUTION

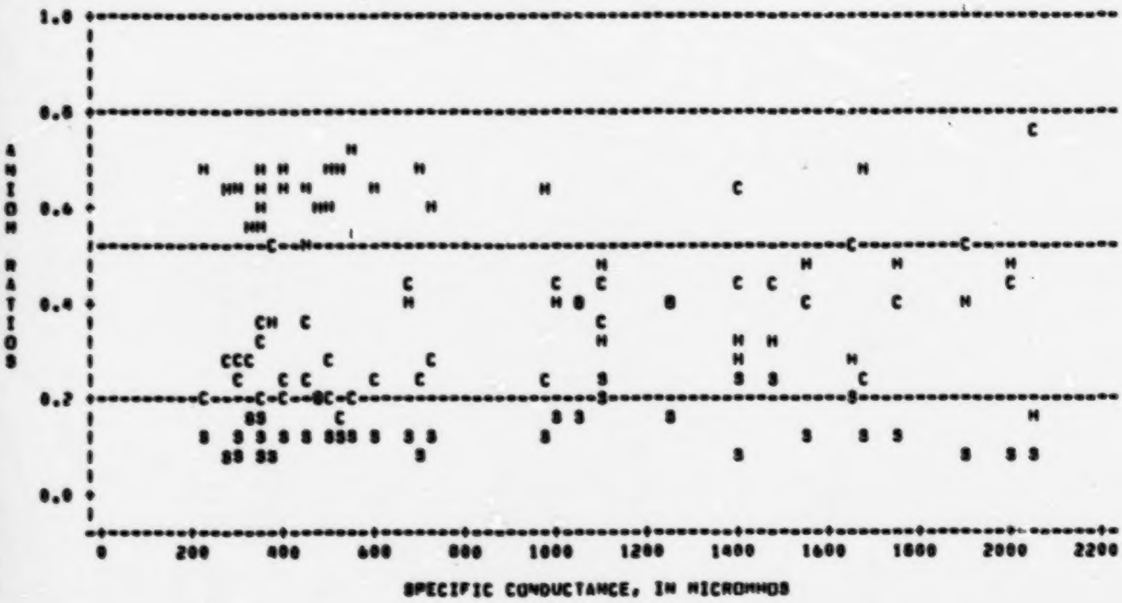
CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	264	352	505	1062	1464
Dissolved solids	213	276	416	766	1082
pH	7.1	7.7	8.0	8.2	8.5
Total hardness	84	110	176	256	348
Chloride	17	29	49	116	232
Sulfate	13	22	36	90	114
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.8	1.1	1.7	3.3	4.6
Boron					

BEST DOCUMENT AVAILABLE

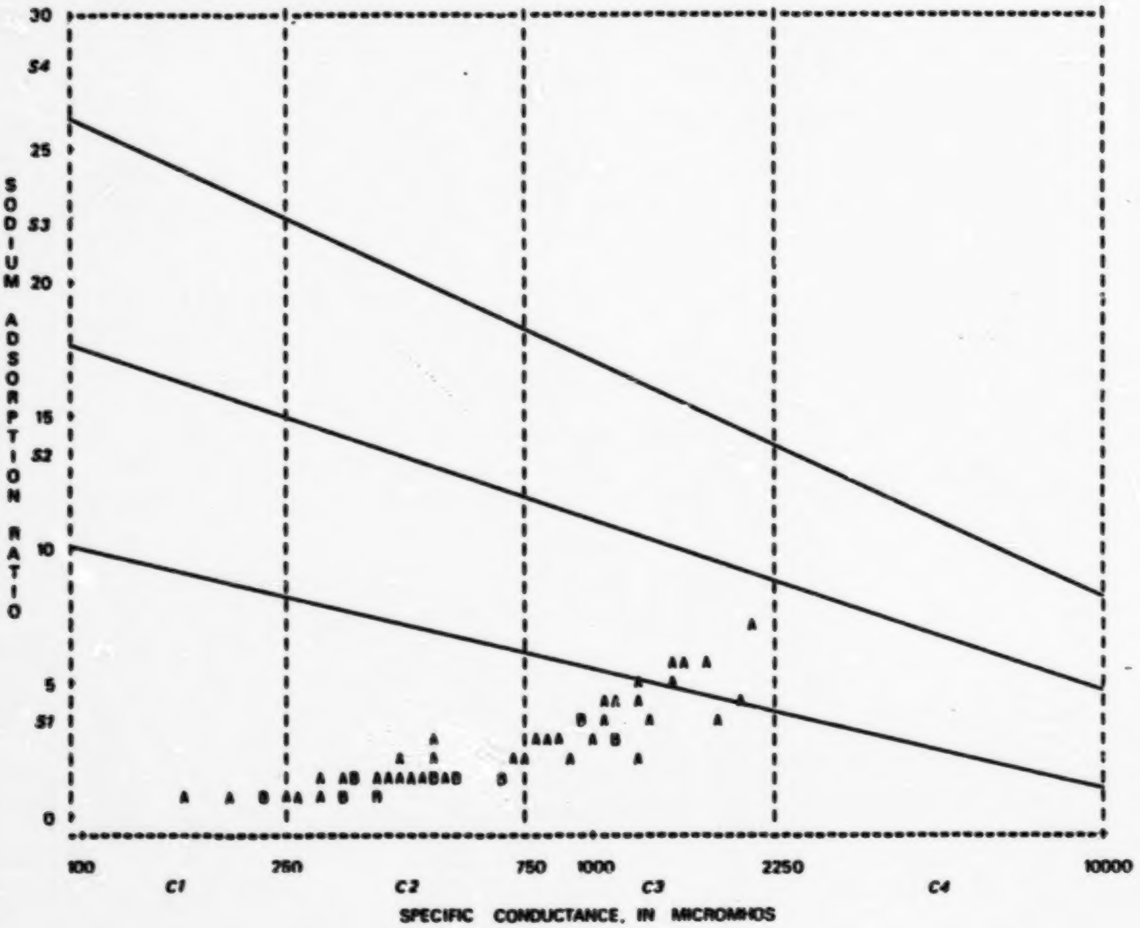
CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=RED ROCK CREEK NR RED ROCK, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=RED ROCK CREEK NR RED ROCK, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=RED ROCK CREEK NR RED ROCK, OK



ARKANSAS RIVER MAINSTEM

07245500 - Sallisaw Creek near Sallisaw, Okla.

LOCATION.--Lat 35°27'52", long 94°51'43". in SW¼ sec.34, T.12 N., R.23 E., Sequoyah County, at abandoned county road bridge, 300 ft upstream from U.S. Highway 64, 400 ft downstream from water-supply dam of City of Sallisaw, 3.5 mi west of Sallisaw, 5 mi upstream from Little Sallisaw Creek, and at mile 9.0.

DRAINAGE AREA.--182 mi^2.

PERIOD OF RECORD.--1952 to 1963, 1977.

WATER TYPE.--The water was calcium bicarbonate type. Calcium made up about 80 percent of the cations, and bicarbonate made up about 80 percent of the anions.

TREND.--The current period of record was insufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 71 mg/L and the water was moderately hard. No samples had a hardness greater than 120 mg/L and 17 percent of the hardness values were less than 60 mg/L. No measured constituent exceeded its recommended maximum concentration. No toxic element data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--Both the salinity and the sodium hazards were in the low class for all data. Data indicate that phytotoxicity effects from boron should not occur.

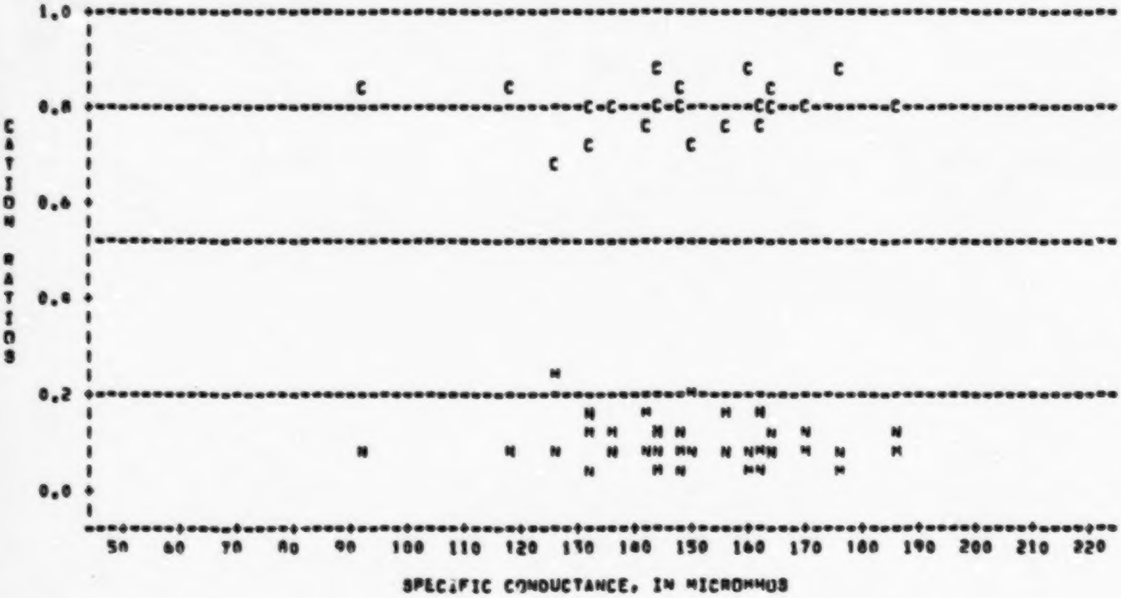
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	72	154	91	220	23	0.29	0.93
Dissolved solids	27	97	71	130	14	.25	.19
pH	71	7.8	6.2	8.2	0.4	-1.94	7.64
Total hardness	70	71	44	119	12	.56	3.41
Chloride	65	4.2	1.3	20	2.6	3.79	21.34
Sulfate	36	9.0	3.3	19	3.6	1.35	2.14
Iron							
Fluoride	19	0.1	0.0	0.3	0.1	2.16	3.82
Arsenic							
Cadmium							
Chromium							
Lead							
Mercury							
SAR	37	0.2	0.1	1.3	0.2	4.21	21.88
Boron	7	31	0	90			

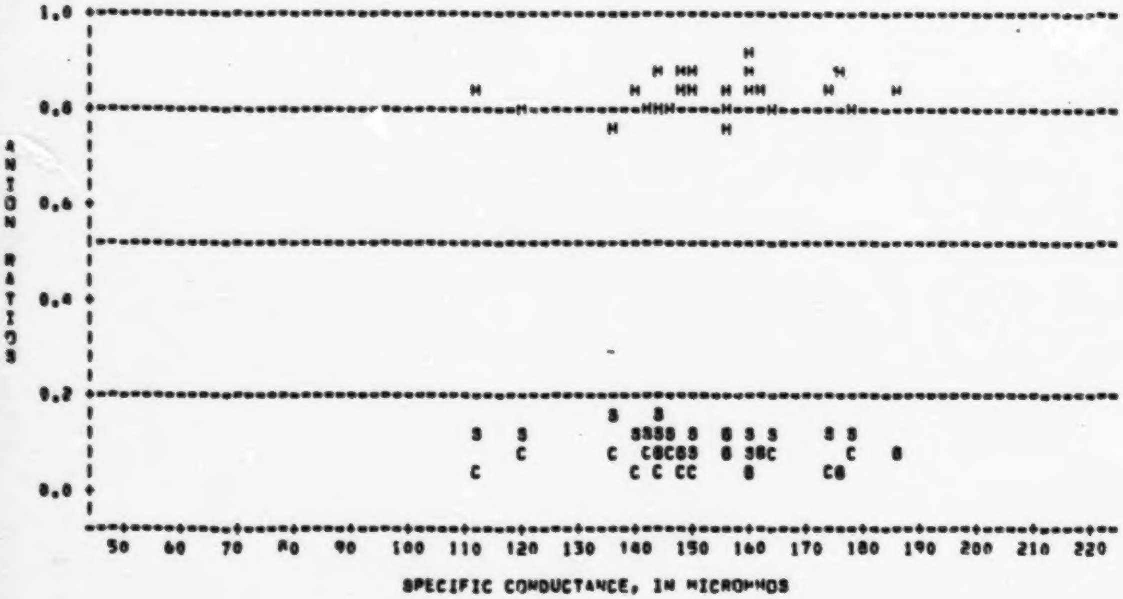
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	121	142	155	163	180
Dissolved solids	75	88	97	102	113
pH	7.4	7.6	7.8	8.0	8.2
Total hardness	56	64	70	78	81
Chloride	2.1	2.6	3.7	5.0	6.8
Sulfate	5.0	6.8	8.4	10	13
Iron					
Fluoride	0.0	0.0	0.0	0.0	0.1
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.0	0.1	0.1	0.2	0.3
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=SALLISAW CREEK NR SALLISAW, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=SALLISAW CREEK NR SALLISAW, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=SALLISAW CREEK NR SALLISAW, OK
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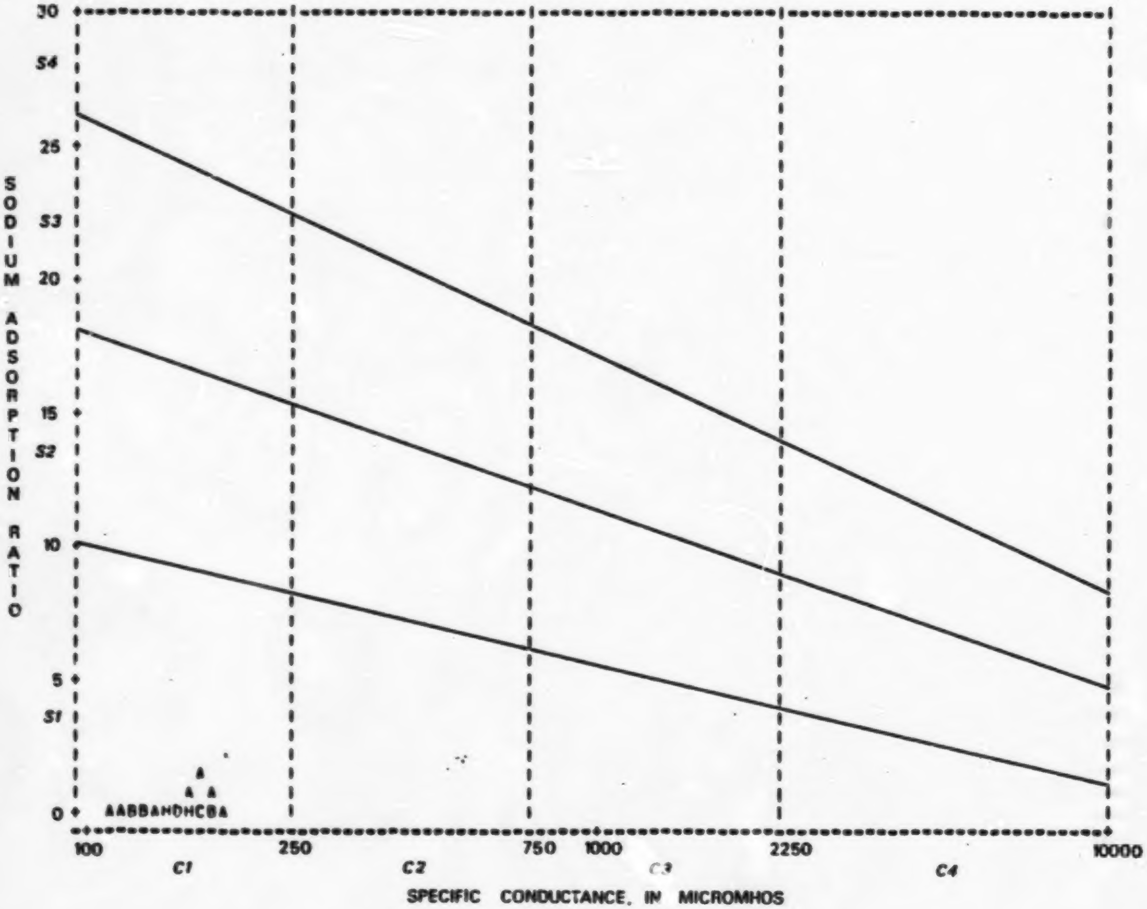


BEST DOCUMENT AVAILABLE

07152400 - Salt Creek near Shidler, Okla.

LOCATION.--Lat 36°45'03", long 93°38'47", in NW¼NE¼ sec.10, T.26 N., R.6 E., Osage County, at bridge on State Highway 18, 1.5 mi south of Shidler.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1950, 1954 to 1955, 1958, 1961 to 1963.

WATER TYPE.--The water was a carbonate/bicarbonate type. Carbonate/bicarbonate was predominant for all samples with sufficient data to determine anion ratios. No cation data were available.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 136 mg/L and the water was hard. Hardness concentration was greater than 120 mg/L for 66 percent of the hardness values. Eight percent of the hardness values were greater than 180 mg/L, very hard class. None of the measured constituents exceeded recommended maximum concentration limits. No toxic element data were available. Based on the data, this water is probably suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to high, with less than 5 percent of the samples in the high salinity hazard class. The sodium hazard was low class for all SAR values. No boron data were available.

07152400 - Salt Creek near Shidler, Okla.--Continued

UNIVARIATE STATISTICS

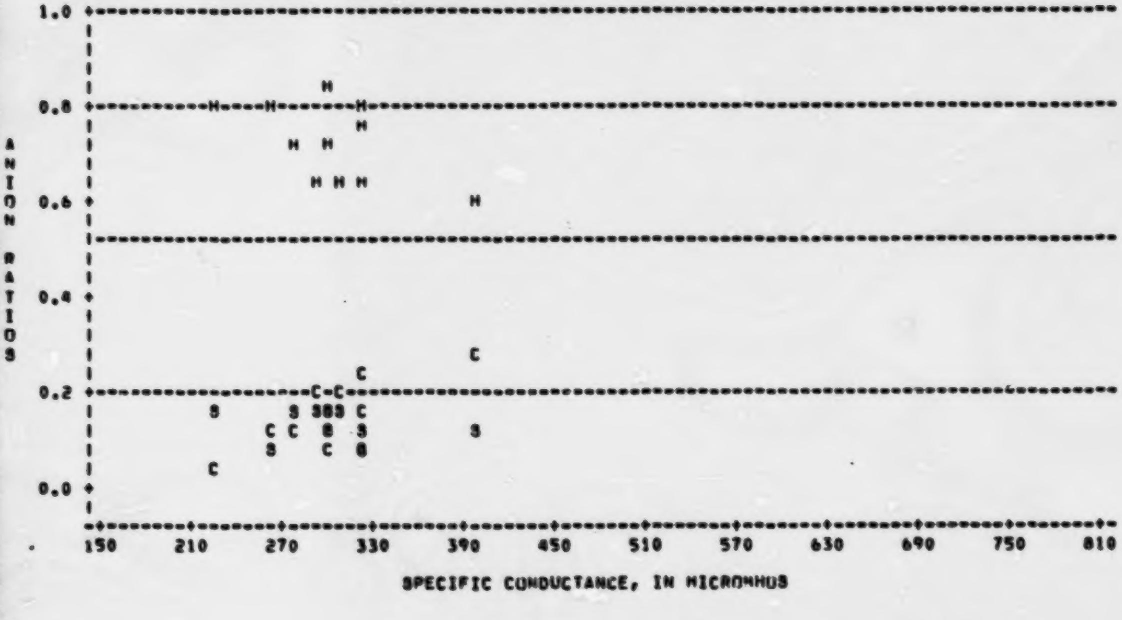
CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	24	371	182	810	128	1.79	5.07
Dissolved solids	12	204	138	255	33	-.62	0.22
pH	22	8.3	7.4	8.7	0.3	-1.10	1.69
Total hardness	24	136	78	216	34	.79	.64
Chloride	24	25	3.9	108	22	2.69	8.43
Sulfate	12	12	11	24	4.4	-.55	-.96
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	2	0.8	0.7	0.8			
Boron	0						

FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	242	295	319	422	481
Dissolved solids	143	172	203	223	229
pH	7.8	8.1	8.3	8.4	8.6
Total hardness	90	112	130	144	178
Chloride	7.0	13	19	24	40
Sulfate	11	14	18	22	23
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR					
Boron					

No cation distribution data are available.

ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=SALT CREEK NR SHIDLER, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=SALT CREEK NR SHIDLER, OK
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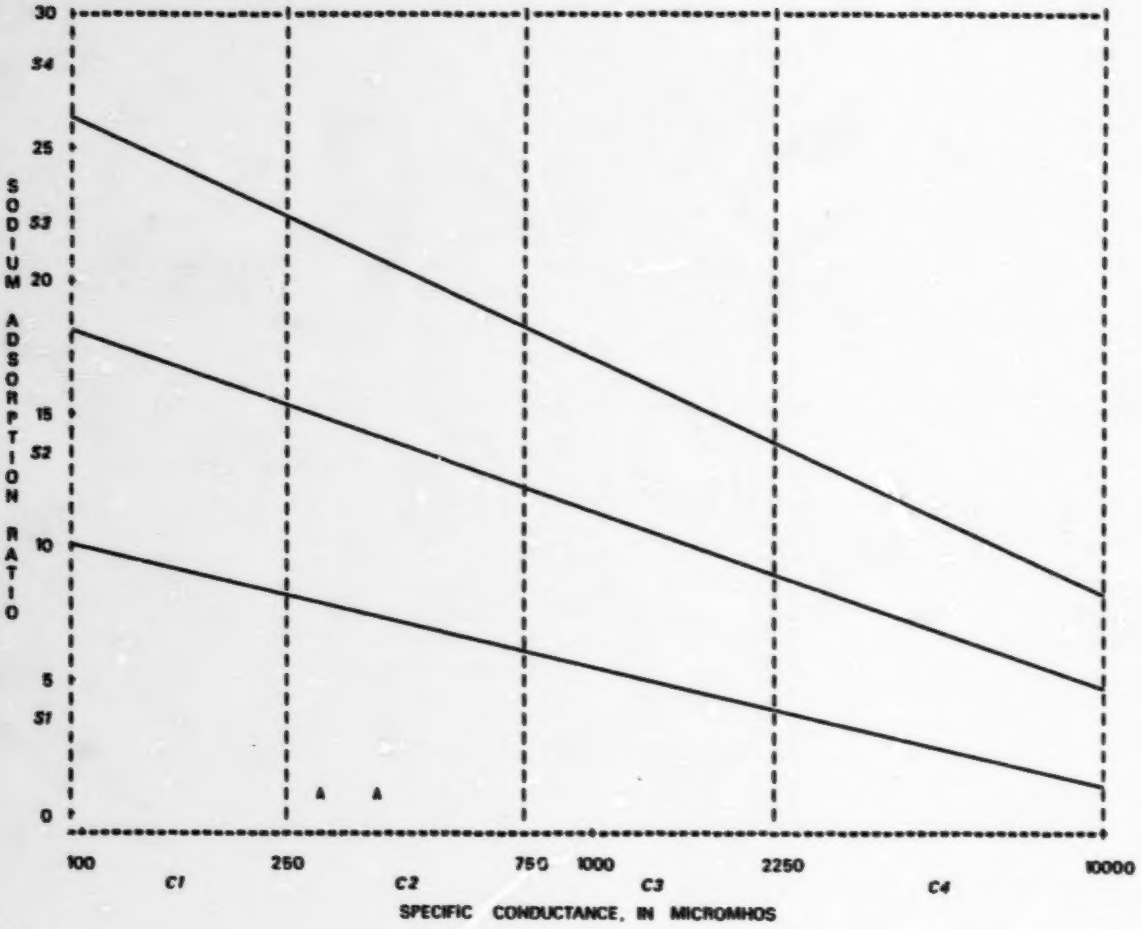


BEST DOCUMENT AVAILABLE

07246000 - Sans Bois Creek near Keota, Okla.

LOCATION--Lat 35°15'37", long 94°57'57", in NW¼NW¼ sec.15, T.19 N., R.22 E., Haskell County, at bridge on State Highway 9, 3 mi west of Keota.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1958 to 1963.

WATER TYPE.--The water was mixed type. For specific conductances greater than 900 umhos, which occurred in 7 percent of the samples, the sulfate ion ratio increased.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 82 mg/L and the water was moderately hard. Hardness concentrations greater than 120 mg/L, hard or very hard classes, occurred for 20 percent of the hardness values and 70 percent of the values were less than 60 mg/L, soft class. The recommended maximum sulfate concentration of 250 mg/L was exceeded by 14 percent of the sulfate values. No toxic element data were available. Based on the data, this water is probably suitable for use as a public supply, however, indications are that high sulfate concentrations could adversely affect suitability.

IRRIGATION.--The salinity hazard ranged from low to high with 69 percent of the samples having a low salinity hazard. The sodium hazard ranged from low to medium with only about 5 percent of the SAR values having a medium sodium hazard. Data indicated that adverse effects from boron phytotoxicity could occur even in boron tolerant plants.

07246000 - Sans Bois Creek near Keota, Okla.--Continued

UNIVARIATE STATISTICS

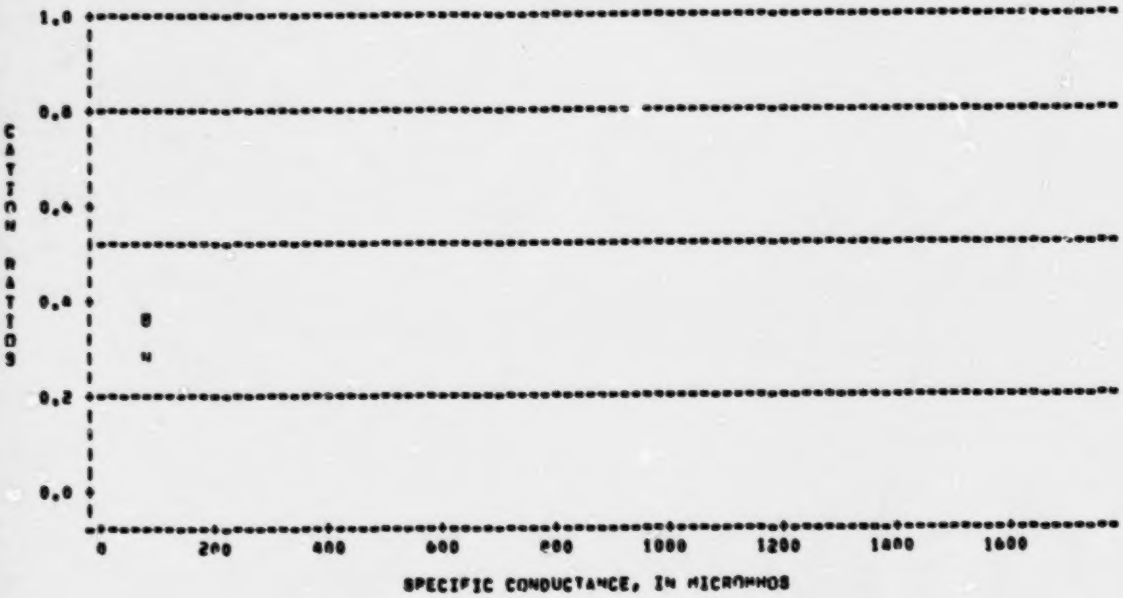
CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	54	302	71	1160	296	1.67	1.64
Dissolved solids	38	190	70	739	189	1.91	2.23
pH	53	7.7	6.2	8.8	0.5	-0.31	0.53
Total hardness	54	82	18	380	85	2.05	3.44
Chloride	49	6.0	2.0	14	2.7	1.38	2.19
Sulfate	43	75	9.4	414	115	2.06	2.78
Iron	0						
Fluoride	8	0.2	0.1	0.6			
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	1	0.4					
Boron	5	694	0	2700			

FREQUENCY DISTRIBUTION

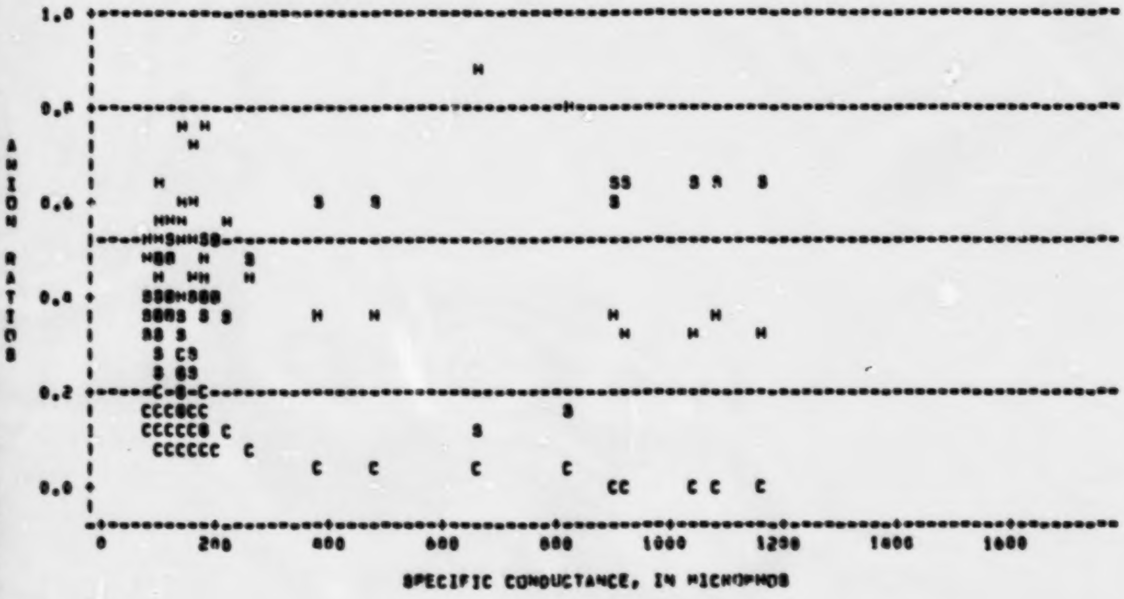
CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	101	116	155	368	863
Dissolved solids	80	87	104	144	582
pH	7.0	7.4	7.7	8.1	8.4
Total hardness	25	33	45	79	214
Chloride	3.1	4.1	5.2	7.2	8.7
Sulfate	11	16	26	42	306
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR					
Boron					

BEST DOCUMENT AVAILABLE

CATION RATIO PLOT
S IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=SANS BOIS CREEK NR KEOTA, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=SANS BOIS CREEK NR KEOTA, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=SANS BOIS CREEK NR KEOTA, OK
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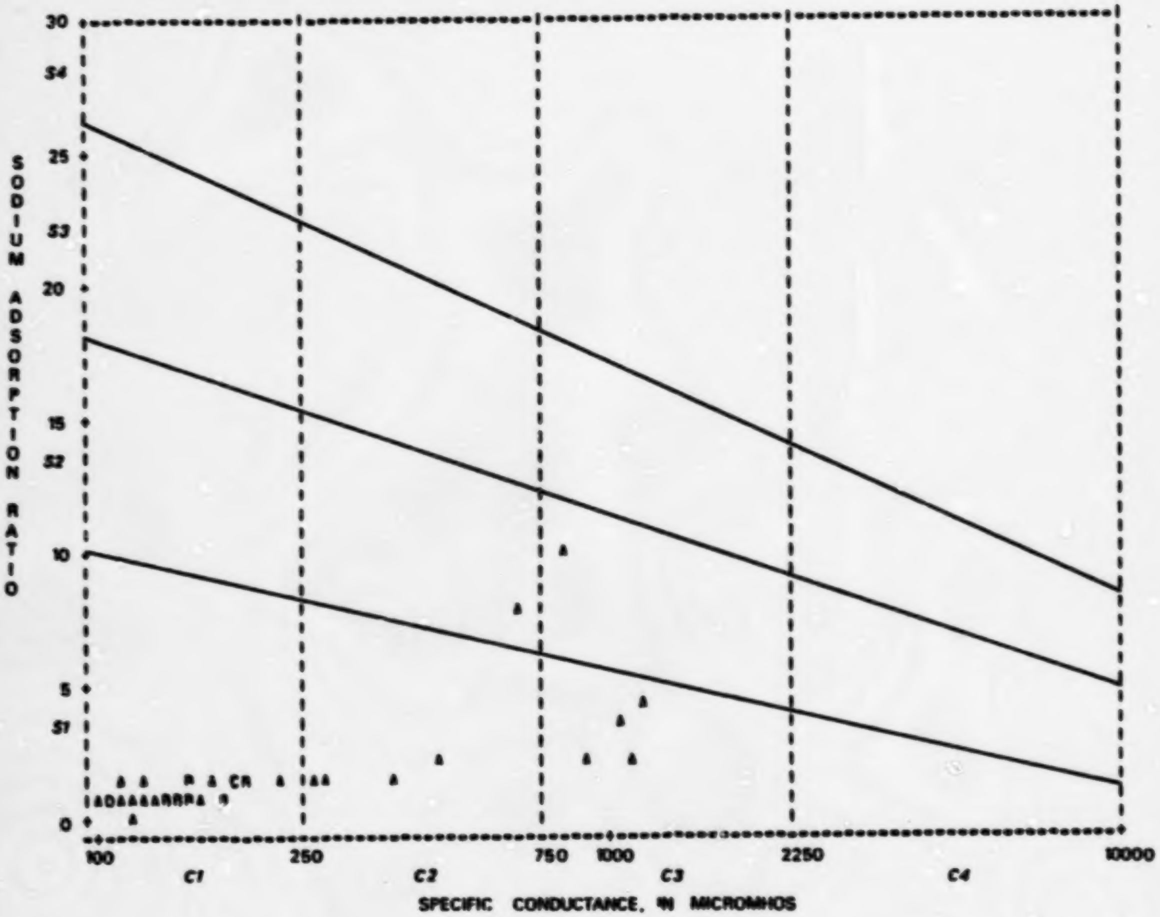


BEST DOCUMENT AVAILABLE

VERDIGRIS RIVER BASIN

07176455 - Birch Creek near Barnsdall, Okla.

LOCATION.--Lat 36°33'12", long 96°14'47", in NE¼SE¼ sec.17, T.24 N., R.10 E., Osage County, at bridge on county road, 4.5 mi west of Barnsdall.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1965 to 1966.

WATER TYPE.--The water was sodium chloride type. Data for the sodium ion ratio was limited and shows it to be slightly less than 50 percent. Based on anion ratio data, it would appear that the sodium ion ratio should increase as the specific conductance increases. The chloride ion ratio was predominant throughout the range of measured specific conductance.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 87 mg/L and the water was moderately hard. Thirty-eight percent of the hardness values had concentrations in the soft class, less than 60 mg/L, and 19 percent of the hardness values were in the hard or very hard class. None of the measured constituents exceeded recommended maximum concentrations. No toxic element data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to high with less than 5 percent of the samples having a high salinity hazard. The sodium hazard was low class for all SAR values. No boron data were available.

07176455 - Birch Creek near Barnsdall, Okla.--Continued

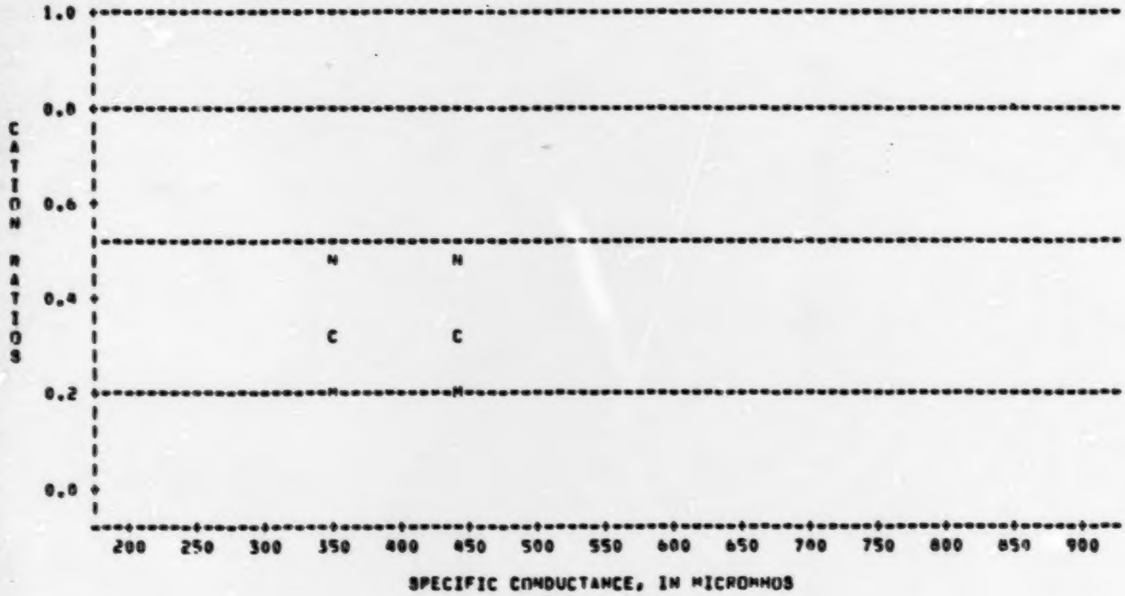
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	21	380	202	865	194	1.18	0.44
Dissolved solids	21	243	130	468	107	0.96	-.35
pH	21	7.4	6.5	7.9	0.4	-.59	-.61
Total hardness	21	87	42	188	41	1.08	.38
Chloride	21	75	26	196	48	1.16	.38
Sulfate	21	21	8.0	45	11	.97	.04
Iron	0						
Fluoride	13	0.3	0.1	0.4	0.1	-.87	.35
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	21	1.8	0.9	3.0	0.6	0.45	-0.67
Boron	0						

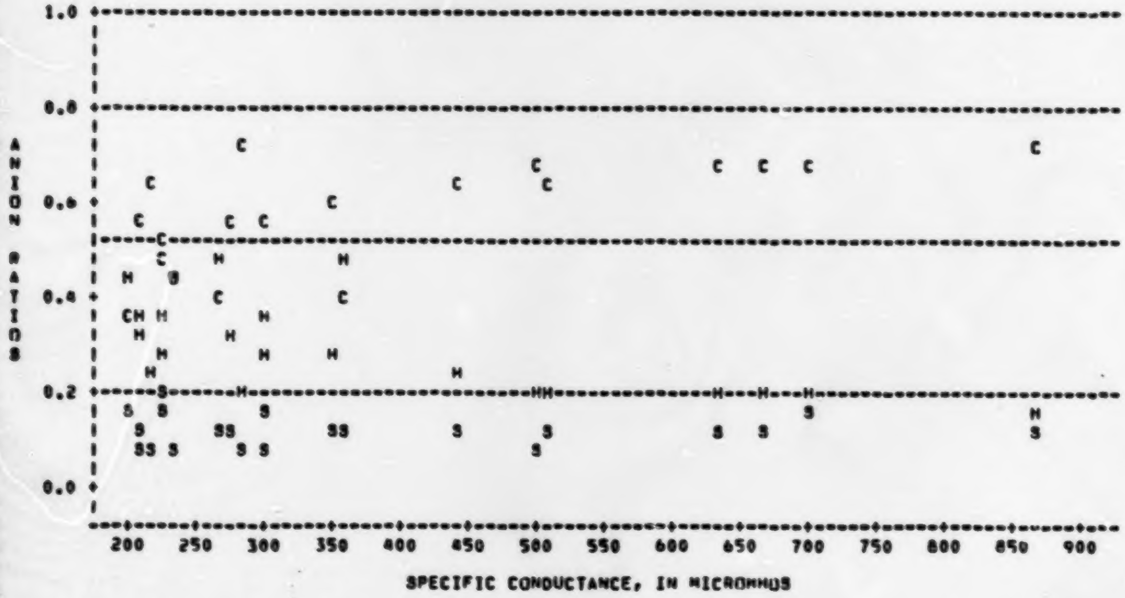
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	205	228	290	488	665
Dissolved solids	140	157	199	303	411
pH	6.5	7.0	7.4	7.6	7.8
Total hardness	44	56	72	105	153
Chloride	30	37	54	104	145
Sulfate	9.2	11	17	26	40
Iron					
Fluoride	0.1	0.2	0.2	0.3	0.3
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	1.0	1.3	1.6	2.2	2.6
Boron					

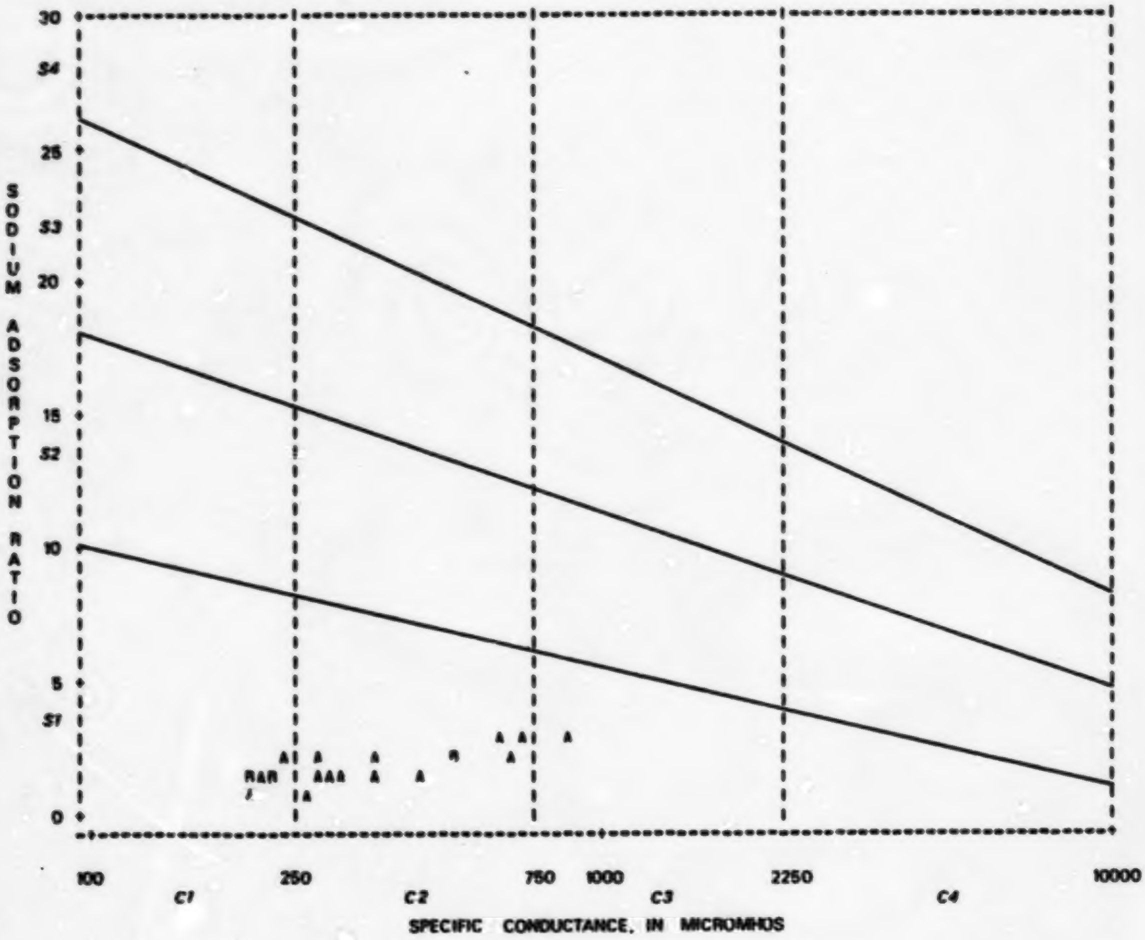
CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BIRCH CREEK NR BARNSDALL, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BIRCH CREEK NR BARNSDALL, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,   C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,   B = 2 OBS,   C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=BIRCH CREEK NR BARNSDALL, OK



VERDIGRIS RIVER BASIN

07176350 - Bird Creek near Barnsdall, Okla.

LOCATION.--Lat 36°33'20", long 96°09'22", in NW¼SW¼ sec.17, T.24 N., R.11 E., Osage County, at bridge on State Highway 11, 0.5 mi southeast of Barnsdall.

DRAINAGE.--Not determined.

PERIOD OF RECORD.--1949 to 1953.

WATER TYPE.--The water was calcium bicarbonate type for specific conductances equal to or less than 650 umhos, which occurred in 75 percent of the samples. For specific conductances greater than 650 umhos, the calcium and bicarbonate ion ratios decreased and the water became mixed type.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 195 mg/L and the water was very hard. Hardness was greater than 180 mg/L, very hard class, for 60 percent of the hardness values and concentrations greater than 120 mg/L occurred for 90 percent of the hardness values. None of the measured constituents exceeded recommended maximum concentrations. No toxic element data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from medium to high with 80 percent of the samples having a medium salinity hazard. The sodium hazard was low class for 93 percent of the SAR values. No boron data were available.

07176350 - Bird Creek near Barnsdall, Okla.--Continued

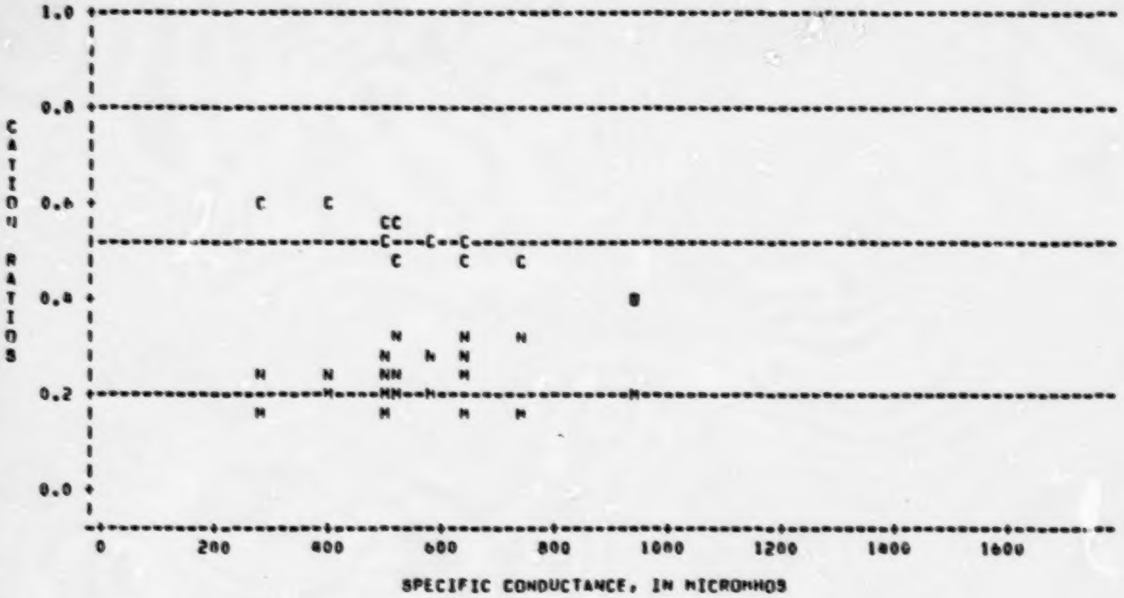
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	20	610	272	1370	251	1.54	3.36
Dissolved solids	20	341	202	810	135	2.39	7.40
pH	13	7.4	7.0	8.0	0.3	-0.19	-1.23
Total hardness	20	195	104	274	46	-.23	-.31
Chloride	20	74	18	225	49	1.78	3.63
Sulfate	20	36	14	182	36	3.73	15.39
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	15	1.6	0.6	4.8	1.1	1.93	4.06
Boron	0						

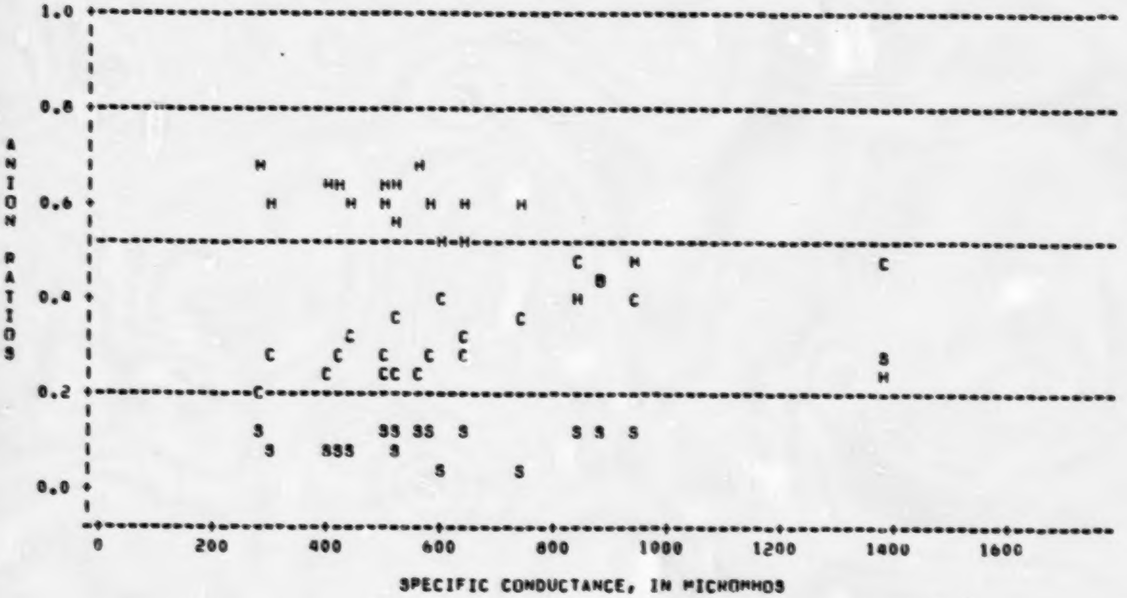
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	306	448	516	647	889
Dissolved solids	215	247	308	360	456
pH	7.0	7.2	7.4	7.7	7.8
Total hardness	115	162	192	223	250
Chloride	30	46	50	86	135
Sulfate	14	18	28	38	48
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.6	0.9	1.2	1.8	2.7
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BIRD CREEK NR BARNSDALL, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BIRD CREEK NR BARNSDALL, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=BIRD CREEK NR BARNSDALL, OK
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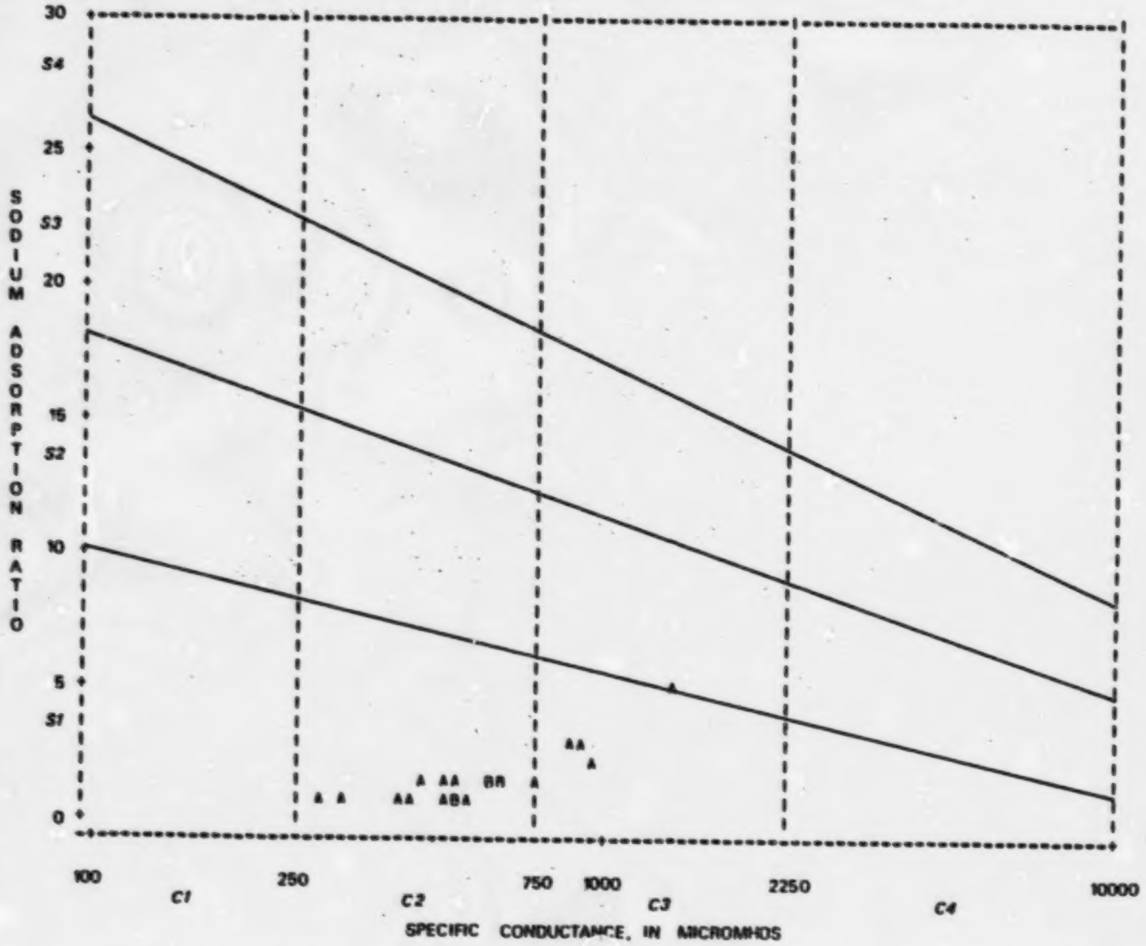


VERDIGRIS RIVER BASIN

07176500 - Bird Creek at Avant, Okla.

LOCATION.--Lat 36°29'11", long 96°03'45", in NW¼ sec.7, T.23 N., R.12 E., Osage County, at county road bridge at Avant, 1.5 mi upstream from Candy Creek, and at mile 54.2.

DRAINAGE AREA.-- 364 mi^2.

PERIOD OF RECORD.--1965 to 1966, 1976 to 1978.

WATER TYPE.--The water was calcium carbonate/bicarbonate type. The anion ratio plot indicated that the chloride ratio increased, probably with a corresponding increase in the sodium ion ratio. It is probable that for specific conductances greater than those measured the water is sodium chloride type.

TREND.--The current period of record was insufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 140 mg/L and the water was hard. Hardness concentration was equal to or greater than 120 mg/L for 70 percent of the hardness values, and greater than 180 mg/L, very hard class, for 15 percent of the values. The recommended upper limit for pH of 9.0 was exceeded by one sample that had a pH of 12.4. No toxic element data were available. Based on the data, this water is probably suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with 97 percent of the samples having a medium salinity hazard. The sodium hazard was low class for all SAR values. No boron data were available.

07176500 - Bird Creek at Avant, Okla.--Continued

UNIVARIATE STATISTICS

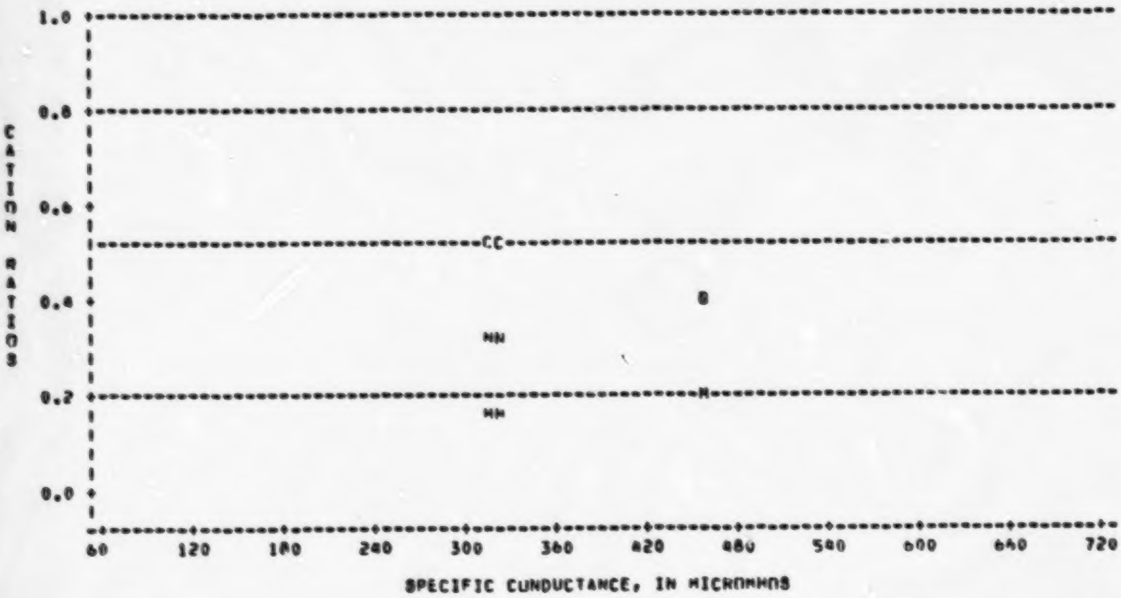
CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	65	436	112	1200	169	2.40	8.06
Dissolved solids	23	233	68	340	68	-0.33	0.10
pH	64	7.8	6.9	12.4	0.7	4.45	29.06
Total hardness	54	140	28	212	38	-.38	.22
Chloride	63	52	1.0	116	26	.81	-.06
Sulfate	50	21	1.0	49	11	.50	.09
Iron	0						
Fluoride	1	0.3					
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	23	1.0	0.6	1.5	0.2	.60	.20
Boron	0						

FREQUENCY DISTRIBUTION

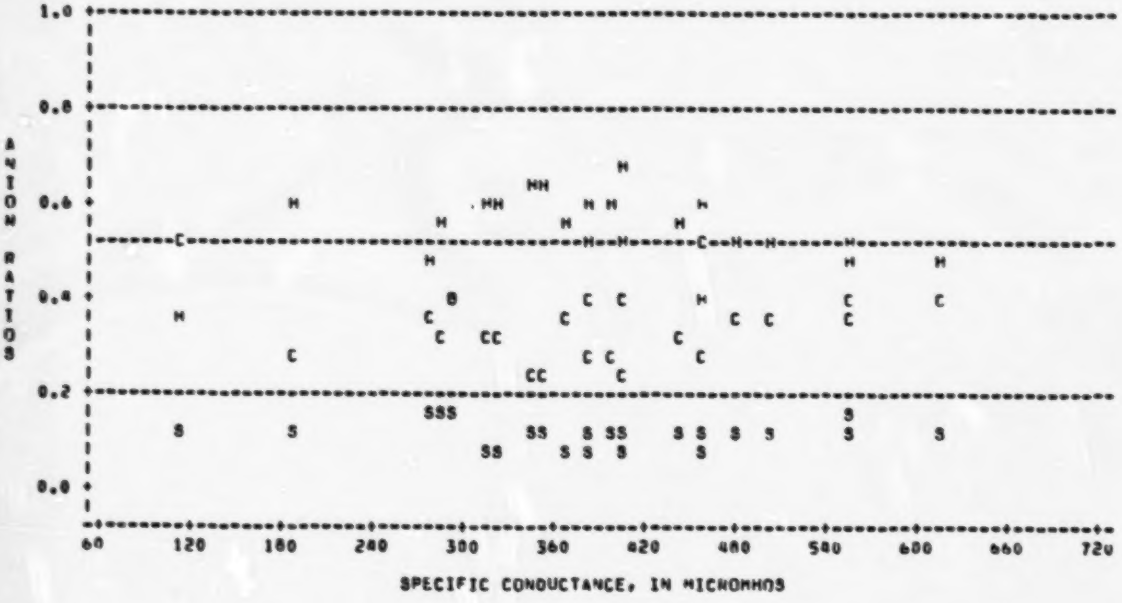
CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	298	344	380	498	585
Dissolved solids	143	187	230	284	320
pH	7.3	7.6	7.8	8.1	8.2
Total hardness	92	114	137	169	187
Chloride	26	33	43	71	92
Sulfate	5.8	13	19	28	34
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.6	0.8	0.9	1.1	1.2
Boron					

BEST DOCUMENT AVAILABLE

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BIRD CREEK AT AVANT, OK

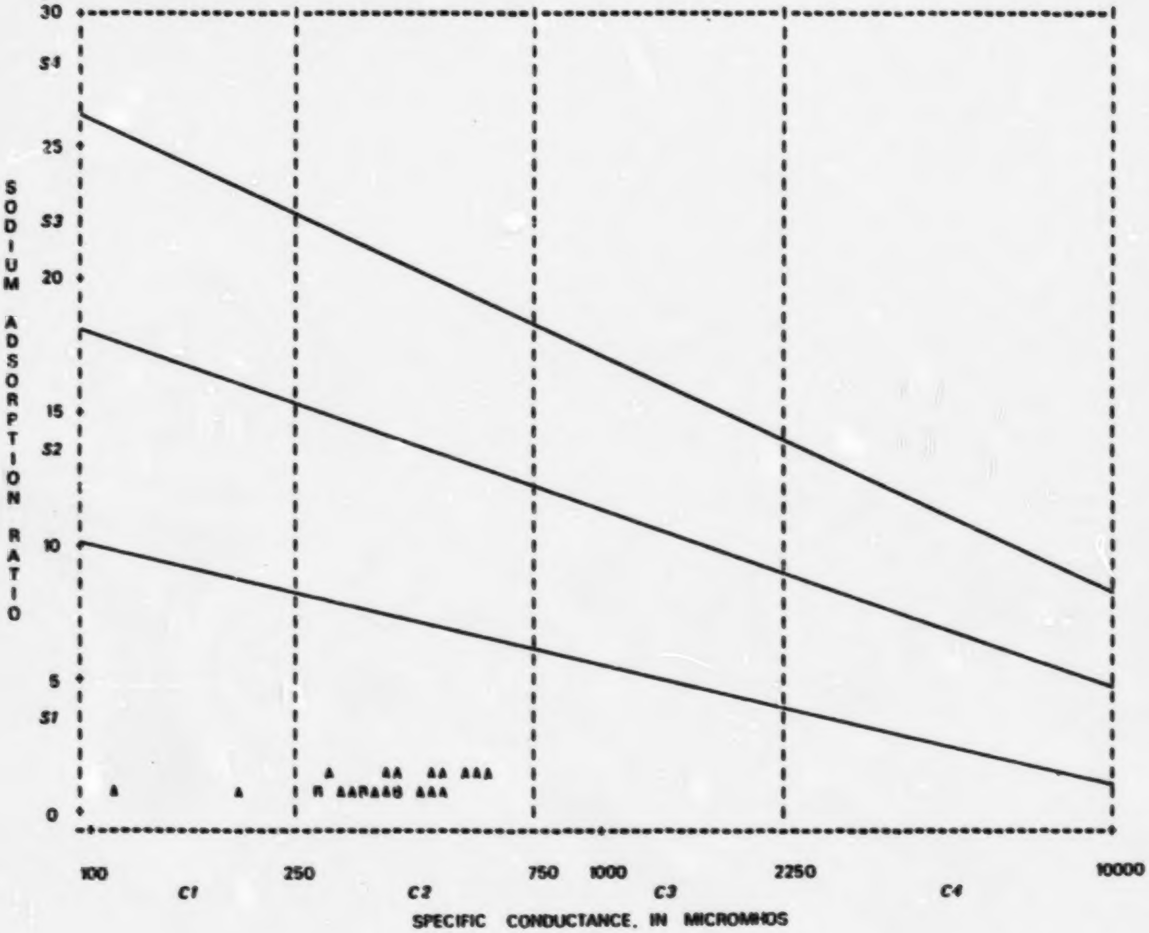


ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BIRD CREEK AT AVANT, OK



BEST DOCUMENT AVAILABLE

IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD, C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=BIRD CREEK AT AVANT, OK



07177500 - Bird Creek near Sperry, Okla.

LOCATION.--Lat 36°16'42", long 95°57'14", in NW¼NW¼ sec.29, T.21 N., R.13 E., Tulsa County, at county road bridge, 1.5 mi upstream from Delaware Creek 2.4 mi downstream from Hominy Creek, 2.5 mi southeast of Sperry, and at mile 25.0.

DRAINAGE AREA.--905 mi^2.

PERIOD OF RECORD.--1952 to 1953, 1960 to 1962, 1965 to 1978.

WATER TYPE.--The water was generally sodium chloride type. The sodium and chloride ions were predominant, when the specific conductance was greater than 300 umhos, which occurred in 91 percent of the samples. For specific conductances less than or equal to 300 umhos, the water approaches calcium carbonate/bicarbonate type, however, generally, the water at the lower specific conductances was mixed type.

TREND.--The plots of dissolved solids and chloride versus time indicated negative trends for dissolved solids and chloride. The plots for hardness and sulfate did not indicate any trend. The Spearman's rhos for dissolved solids and chloride at the 95-percent probability level indicated negative trends. The Spearman's rhos for hardness and sulfate indicated no trend.

PUBLIC WATER SUPPLY.--The average hardness was 218 mg/L and the water was very hard. Hardness concentrations in excess of 180 mg/L, very hard class, occurred for 48 percent of the hardness values and 76 percent of the hardness values were in excess of 120 mg/L. The recommended maximum pH of 9.0 was exceeded in two samples, less than 1 percent. The pH of these two samples was 9.1. The recommended maximum chloride concentration of 250 mg/L was exceeded by 24 percent of the hardness values. No toxic element data were available. Because of the frequency of exceedence of the recommended maximum chloride concentration, this water may not be suitable for use as a public supply.

IRRIGATION.--The sodium and salinity hazards ranged from low to very high. A high or very high salinity hazard occurred in 45 percent of the samples. Approximately 95 percent of the SAR values were low or medium sodium hazard. Data indicate that phytotoxicity effects from boron should not occur.

07177500 - Bird Creek near Sperry, Okla.--Continued

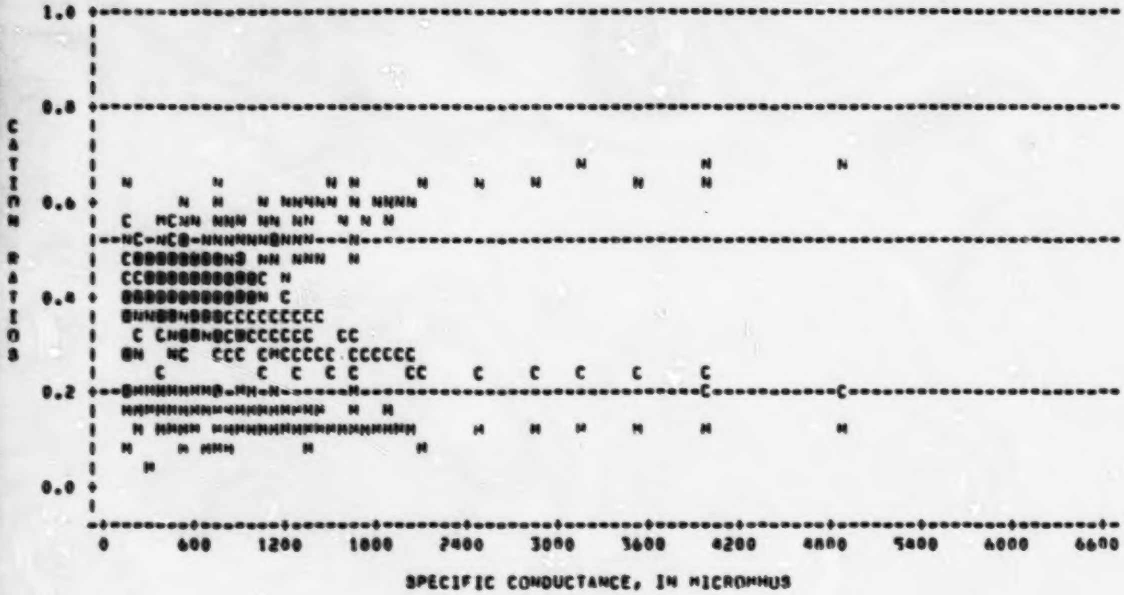
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	785	983	116	6080	955	2.84	8.95
Dissolved solids	761	586	76	3590	560	2.80	8.71
pH	785	7.9	6.2	9.1	0.4	-.52	.66
Total hardness	718	218	32	924	152	2.11	5.15
Chloride	773	232	9.2	1910	301	3.09	10.47
Sulfate	679	23	5.4	67	8.7	.62	.65
Iron	0						
Fluoride	65	0.2	0.0	0.5	0.1	.23	-.84
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	608	3.0	0.5	13	2.4	2.08	4.33
Boron	60	109	0	430	94	1.53	2.13

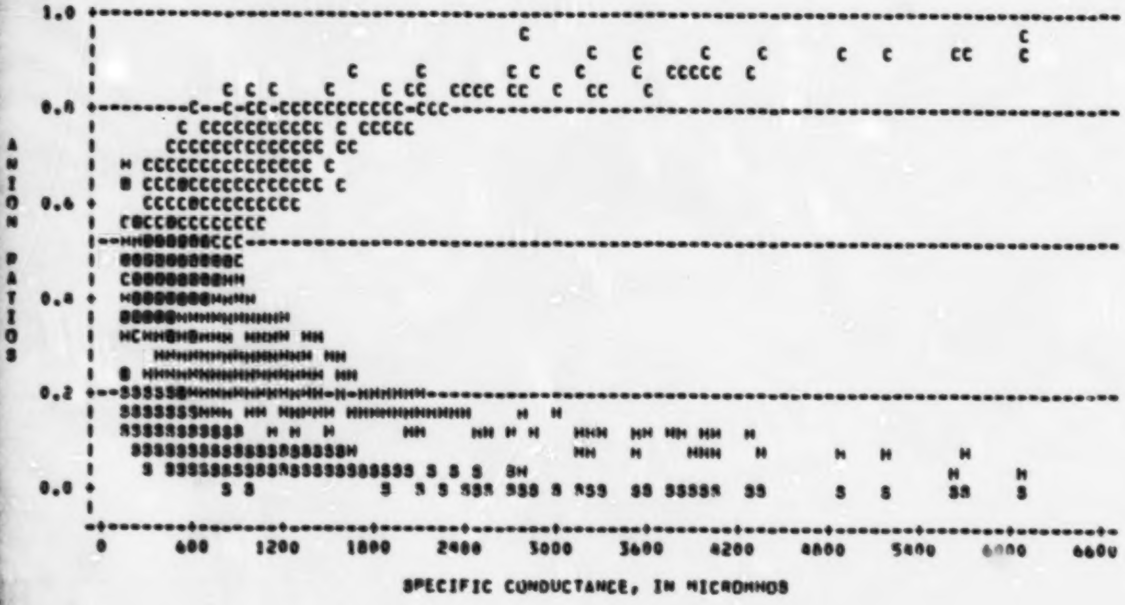
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	317	477	698	1070	1837
Dissolved solids	202	290	410	631	1100
pH	7.3	7.6	7.9	8.2	8.3
Total hardness	84	124	179	259	381
Chloride	47	78	132	240	475
Sulfate	13	17	22	29	35
Iron					
Fluoride	0.1	0.1	0.2	0.3	0.3
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	1.1	1.5	2.2	3.4	6.0
Boron	10	50	80	130	250

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BIRD CREEK NR SPERRY, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BIRD CREEK NR SPERRY, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=BIRD CREEK NR SPERRY, OK
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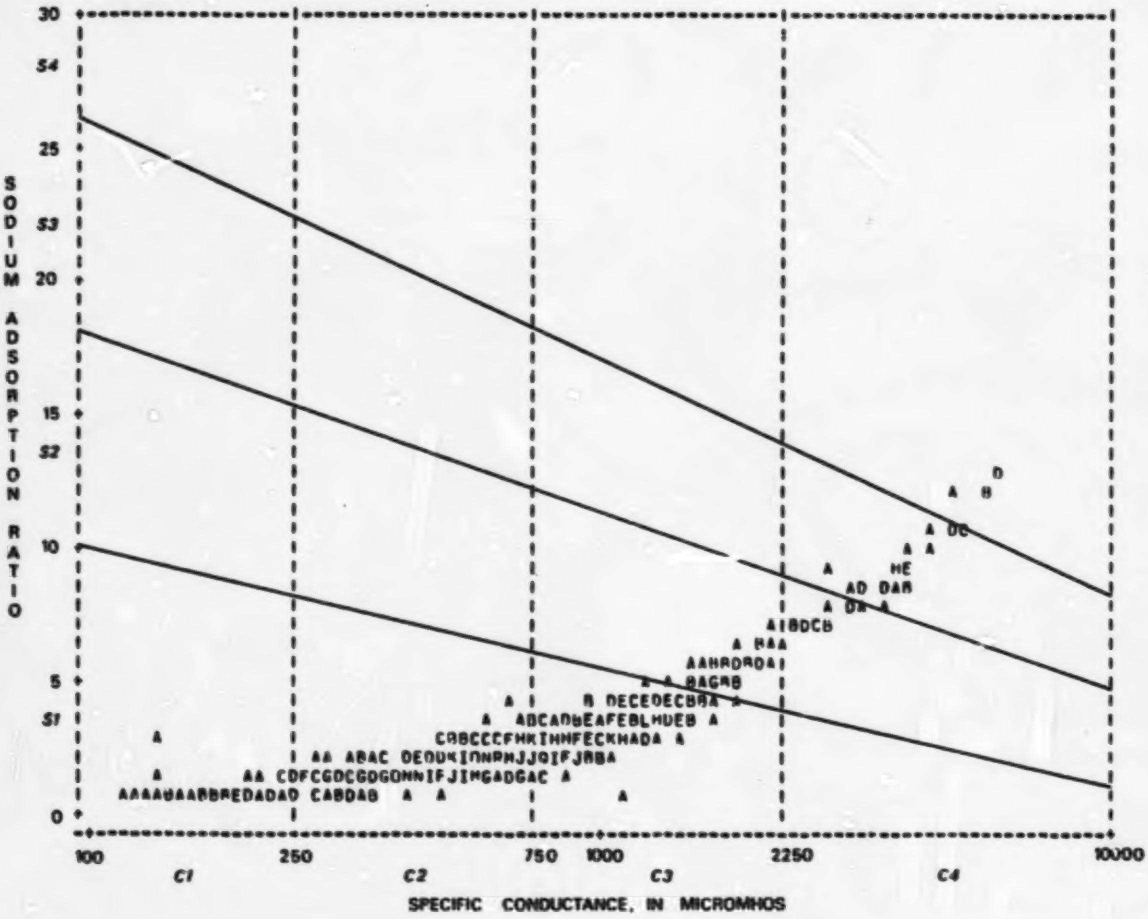


07178050 - Bird Creek near Catoosa, Okla.

LOCATION.--Lat 36°13'51", long 95°49'55", in NW¼SW¼ sec.5, T.20 N., R.14 E., Tulsa County, at bridge on U.S. Highway 75, approximately 5.5 mi northwest of Catoosa.

DRAINAGE AREA.--1,080 mi^2.

PERIOD OF RECORD.--1965 to 1978.

WATER TYPE.--The water was generally chloride type. The chloride ion was predominant for specific conductances greater than 400 umhos, which occurred in 87 percent of the samples. For specific conductances of 400 umhos or less, there was no predominant ion and the water was mixed type. Sodium and calcium were the principal cations, however, neither of these ions had ratios greater than 50 percent.

TREND.--Plots of dissolved solids and chloride versus time indicated the possibility of negative trends. The Spearman's rhos for dissolved solids and chloride versus time indicated negative trend at the 95-percent probability level. Neither the plots nor the Spearman's rhos for hardness and sulfate indicated any trend.

PUBLIC WATER SUPPLY.--The average hardness was 162 mg/L and the water was hard. Hardness concentrations greater than 120 mg/L occurred for 82 percent of the hardness values and 17 percent of the hardness values were in excess of 180 mg/L, very hard class. The recommended maximum chloride concentration of 250 mg/L was exceeded by less than 2 percent of the chloride values. No toxic element data were available. Based on the data, this water should be suitable for use a public supply; however, chloride concentrations should be closely monitored.

IRRIGATION.--The salinity hazard ranged from low to high with 81 percent of the samples in the low or medium salinity hazard classes. With one exception, the sodium hazard was low class for all SAR values. The one value had moderate sodium hazard. No boron data were available.

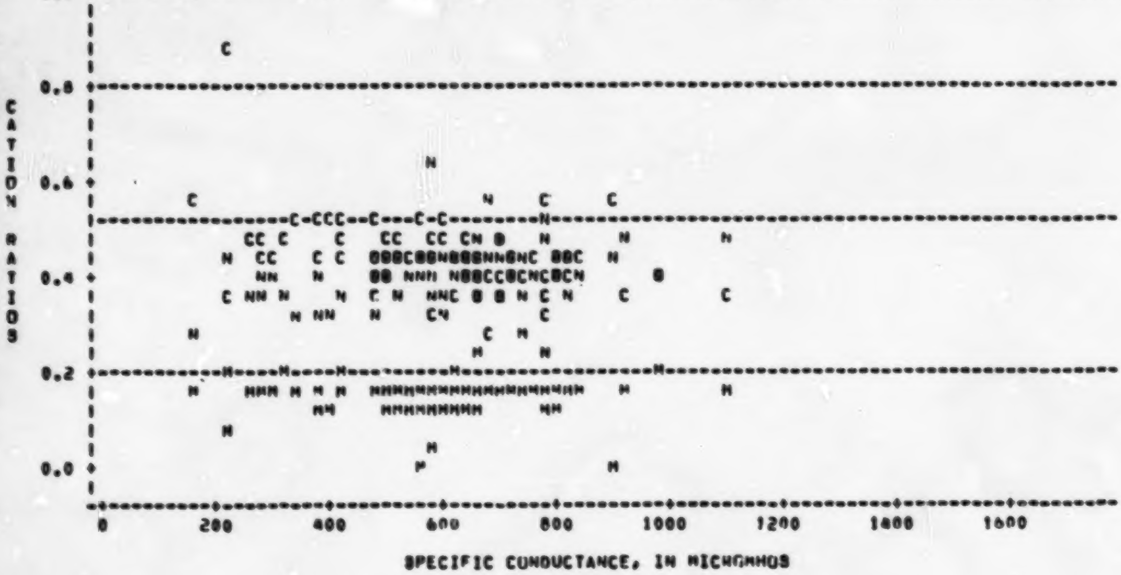
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	247	626	160	2100	232	2.06	9.44
Dissolved solids	180	368	107	846	122	.77	1.65
pH	221	7.5	6.3	8.6	0.4	-.10	.03
Total hardness	179	162	48	310	48	.40	.62
Chloride	186	91	4.0	348	48	1.71	5.18
Sulfate	183	40	1.0	135	16	1.48	6.36
Iron	0						
Fluoride	11	0.4	0.0	0.9	0.2	.53	1.68
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	173	1.8	0.2	4.8	0.6	.96	2.71
Boron	0						

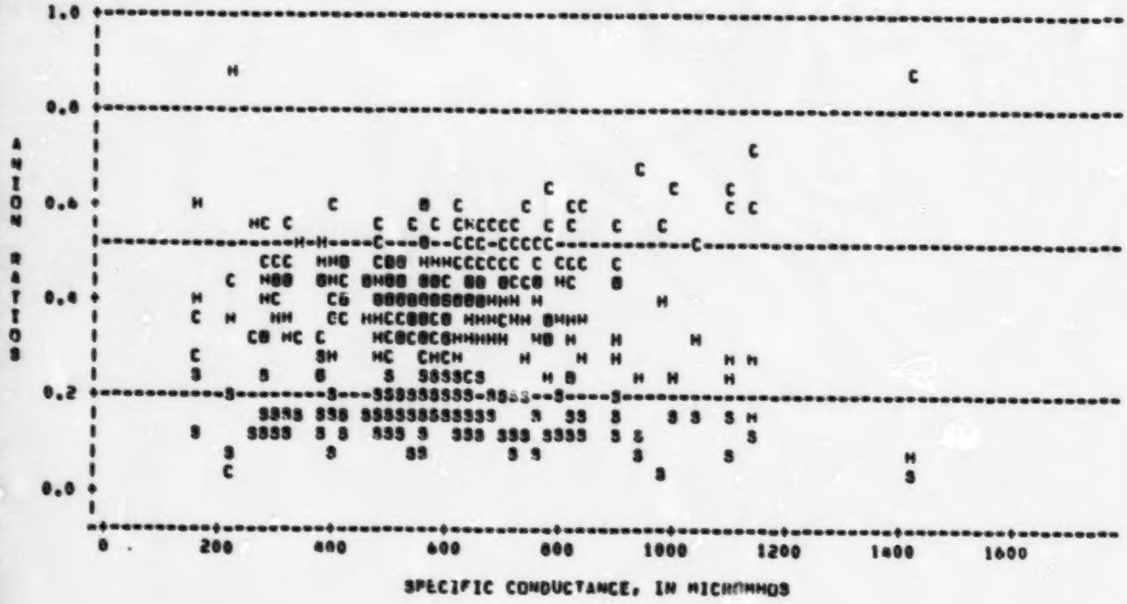
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	380	508	600	703	848
Dissolved solids	212	301	357	426	518
pH	7.0	7.3	7.5	7.8	8.1
Total hardness	101	134	160	186	221
Chloride	43	60	83	110	144
Sulfate	22	30	39	47	58
Iron					
Fluoride	0.0	0.2	0.3	0.4	0.6
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	1.1	1.4	1.8	2.1	2.6
Boron					

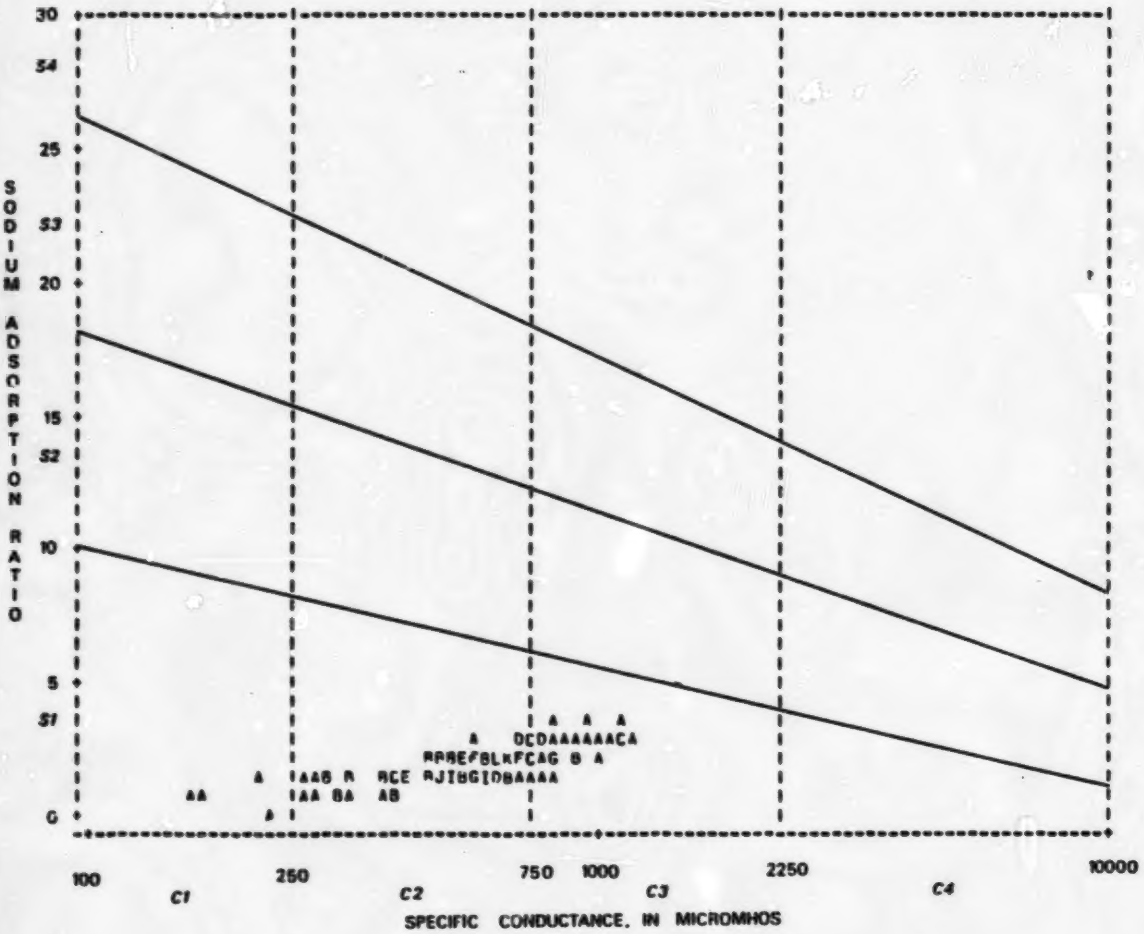
CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BIRD CREEK NR CATOOSA, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BIRD CREEK NR CATOOSA, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,   C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,   B = 2 OBS,   C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=BIRD CREEK NR CATOOSA, OK



BEST DOCUMENT AVAILABLE

07173000 - Caney River near Hulah, Okla.

LOCATION.--Lat 36°55'06", long 96°04'15", in NW¼SE¼ sec.12, T.28 N., R.11 E., Osage County, on left bank 1,000 ft downstream from the Atchison, Topeka, and Santa Fe Railway Co. bridge, 0.9 mi downstream from Hulah Dam. 1.5 mi upstream from Opossum Creek, 2.5 mi west of Hulah, and at mile 95.3.

DRAINAGE AREA.--736 mi^2.

PERIOD OF RECORD.--1952 to 1953, 1956, 1958, 1960, 1963 to 1964, 1976 to 1978.

WATER TYPE.--The water was calcium carbonate/bicarbonate type. The carbonate/bicarbonate ion ratio was in excess of 50 percent throughout the range of measured specific conductances. The calcium ion ratio was less than 50 percent for specific conductances about 400 umhos.

TREND.--The current period of record was insufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 165 mg/L and the water was hard. Hardness concentrations greater than 120 mg/L occurred for 80 percent of the hardness values and 35 percent of the hardness values were greater than 180 mg/L, very hard class. None of the measured constituents exceeded recommended maximum limits. No toxic element data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with 96 percent of the samples in the medium salinity hazard class. The sodium hazard was low class for all SAR values. No boron data were available.

07173000 - Caney River near Hulah, Okla.--Continued

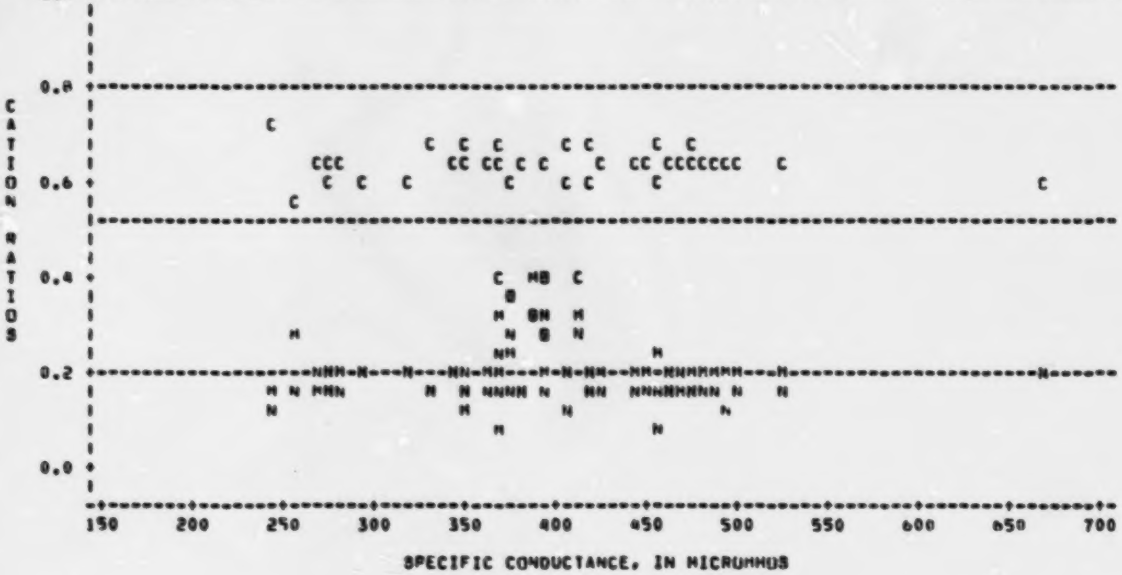
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	107	395	190	668	83	0.08	0.31
Dissolved solids	12	284	223	383	36	1.67	6.05
pH	90	7.9	6.0	8.8	0.4	-1.19	3.53
Total hardness	81	165	99	286	39	.36	-.17
Chloride	107	27	1.0	102	15	1.71	5.73
Sulfate	39	22	1.0	34	9.6	-.70	-.51
Iron	0						
Fluoride	1	0.4					
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	50	0.6	0.3	1.0	0.2	0.82	0.24
Boron	0						

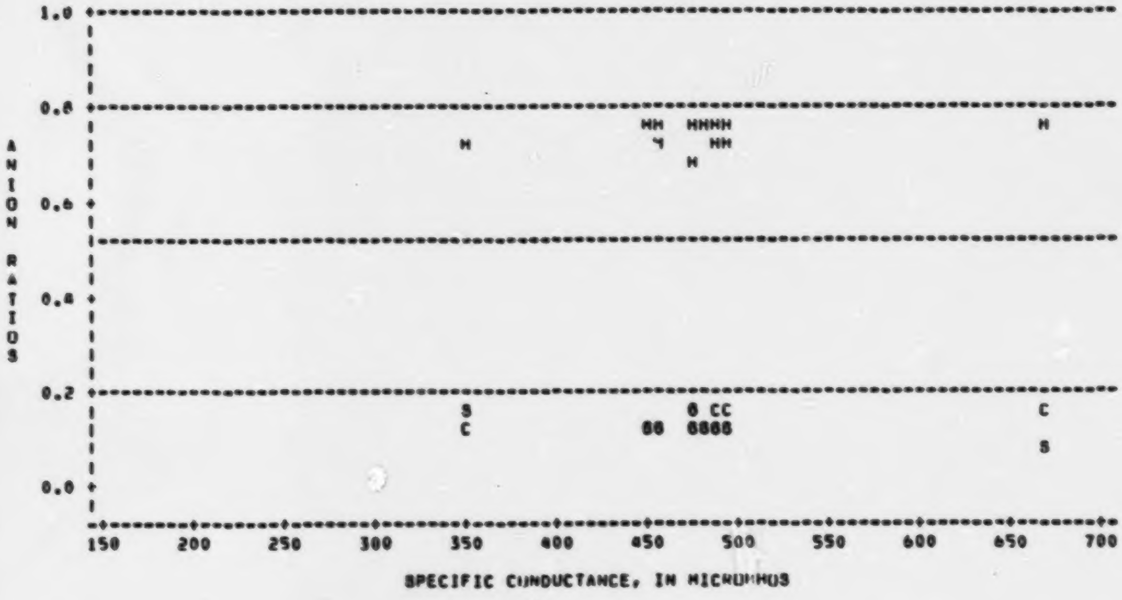
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	279	339	390	462	491
Dissolved solids	231	272	281	288	291
pH	7.4	7.6	7.9	8.1	8.3
Total hardness	112	136	160	198	210
Chloride	14	18	23	32	45
Sulfate	6.6	15	24	31	33
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.4	0.5	0.5	0.7	0.8
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER NR MULAH, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER NR MULAH, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD.  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER NR HULAH, OK
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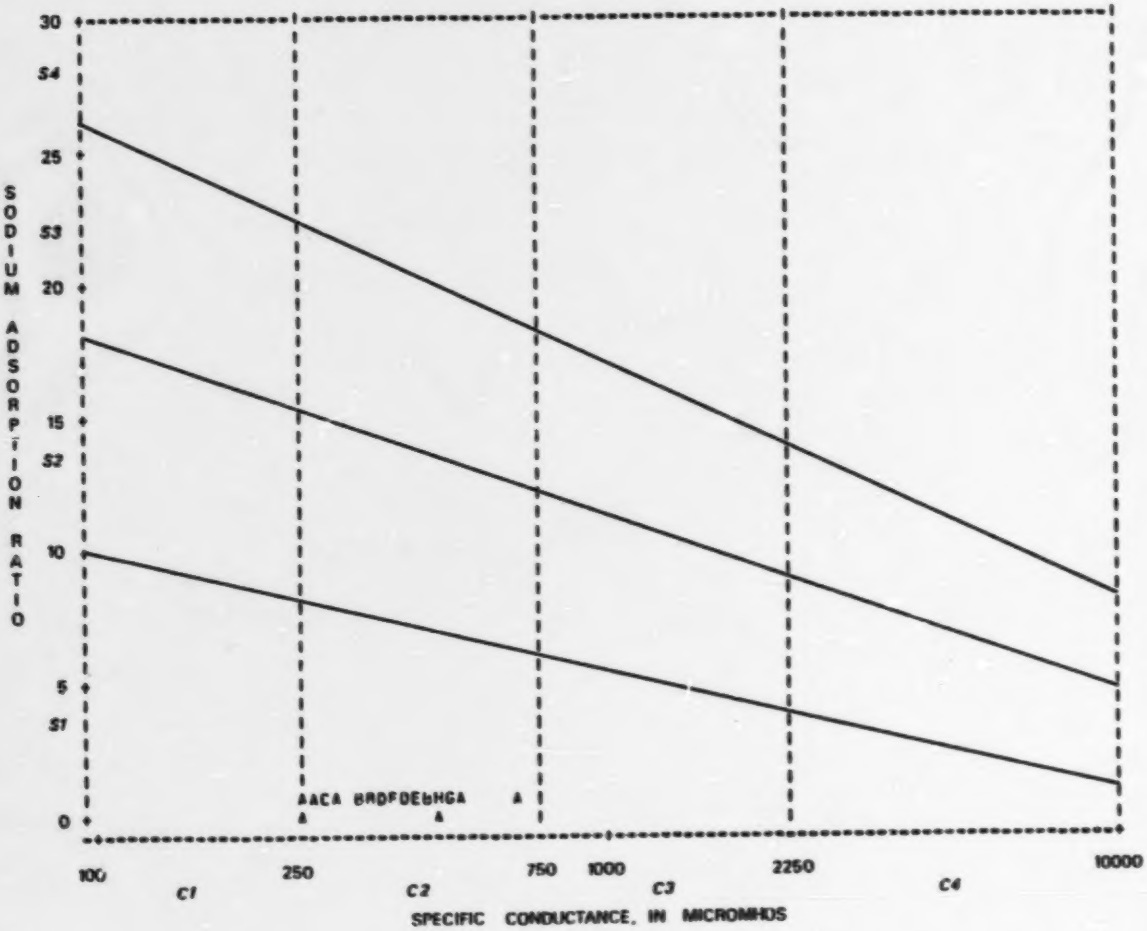


07174500 - Caney River at Bartlesville, Okla.

LOCATION.--Lat 36°43'10", long 95°57'20", in SE¼NE¼ sec.7, T.26 N., R.13 E., Washington County, at bridge on State Highway 23, 0.5 mi upstream from Sand Creek, and 0.6 mi east of Bartlesville.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1952 to 1953, 1967 to 1968.

WATER TYPE.--The water was generally chloride type. Chloride was predominant for specific conductances greater than 600 μmhos, which occurred in 77 percent of the samples. Carbonate/bicarbonate was predominant for specific conductances less than 400 μmhos, which occurred in 10 percent of the samples. The cation data were not adequate to prepare a ratio plot. Data from stations upstream and downstream of this location indicate the water was calcium carbonate/bicarbonate type at the smaller specific conductances and changed to sodium chloride type with increasing specific conductance.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 231 mg/L and the water was very hard. Hardness concentration was greater than 180 mg/L, very hard class, for 82 percent of the hardness values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 15 percent of the chloride values. Lead data indicate that no toxicity problems should occur. No other toxic element data were available. Based on the data, this water should be suitable for use as a public supply. However, an objectionable salty taste could occur at larger chloride concentrations.

IRRIGATION.--The salinity hazard ranged from medium to high with 65 percent of the samples in the high salinity hazard class. The sodium hazard was low class for all SAR values. No boron data were available.

07174500 - Caney River at Bartlesville, Okla.--Continued

UNIVARIATE STATISTICS

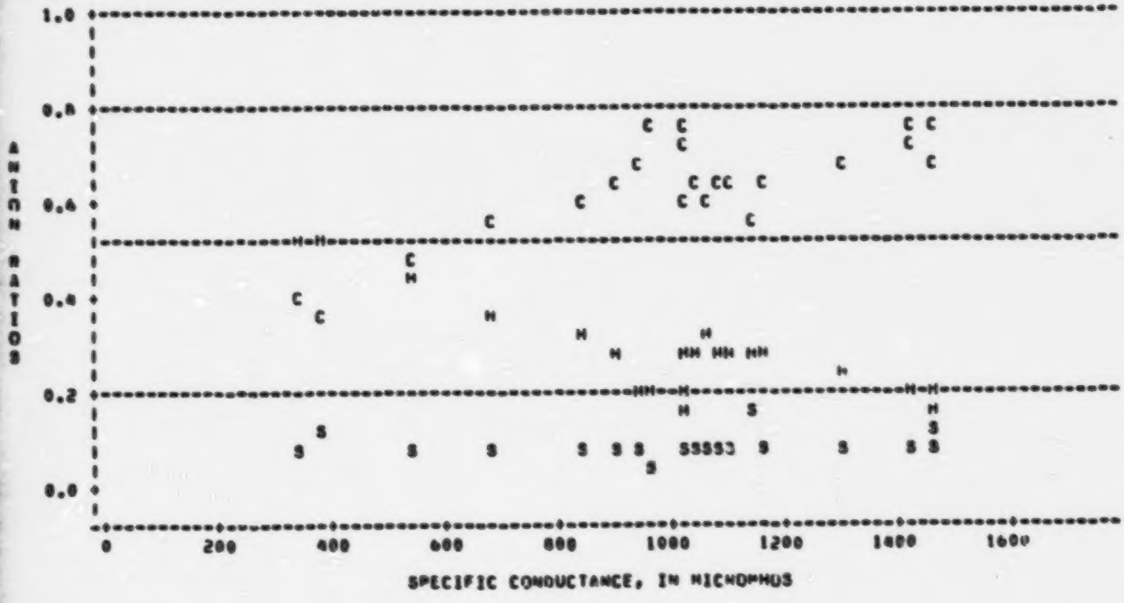
CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	48	879	270	1460	318	-0.13	-0.73
Dissolved solids	23	602	199	931	202	-.34	-.06
pH	44	7.8	6.9	8.4	0.4	-.55	-.80
Total hardness	23	231	112	345	62	-.09	-.71
Chloride	48	173	12	367	88	.05	-.59
Sulfate	48	34	10	89	14	1.80	5.67
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	16	0	0	0	0	--	--
Mercury	0						
SAR	23	2.9	0.9	4.3	0.92	-.94	.18
Boron	0						

FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	371	641	900	1090	1242
Dissolved solids	252	500	616	675	887
pH	7.1	7.4	7.8	8.0	8.1
Total hardness	132	188	218	286	306
Chloride	46	98	190	232	262
Sulfate	19	24	32	40	45
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead	0	0	0	0	0
Mercury					
SAR	1.2	2.4	3.0	3.4	3.7
Boron					

No cation distribution data are available.

ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER AT BARTLESVILLE, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER AT BARTLESVILLE, OK
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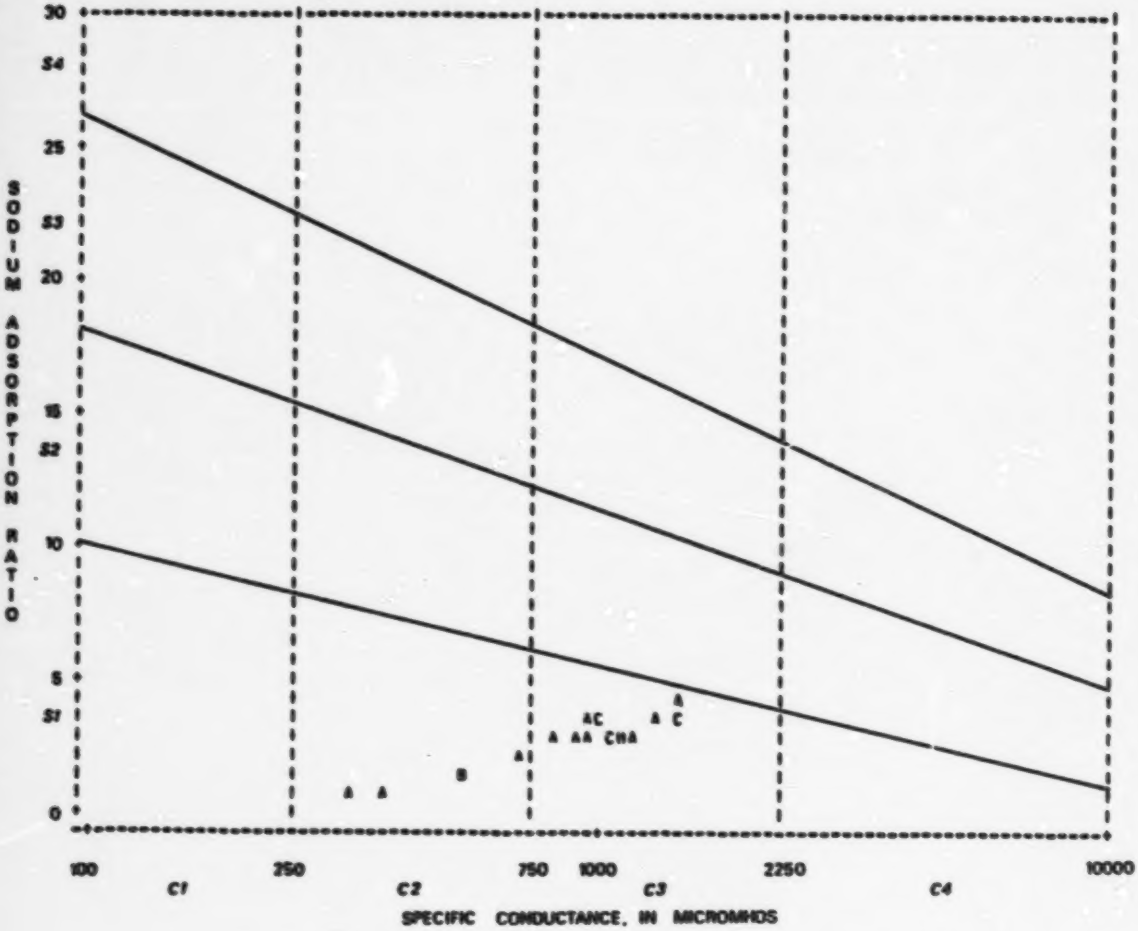


BEST DOCUMENT AVAILABLE

07174700 - Caney River near Ochelata, Okla.

LOCATION.--Lat 36°38'26", long 95°56'02", in SW¼SW¼ sec.16, T.25 N., R.13 E., Washington County, at bridge on U.S. Highway 75, 3.5 mi upstream from Fish Creek, 4.0 mi northeast of Ochelata, 8.0 mi southeast of Bartlesville, and at mile 53.8.

DRAINAGE AREA.--1,753 mi^2.

PERIOD OF RECORD.--1960 to 1961.

WATER TYPE.--The water was calcium carbonate/bicarbonate type for specific conductance less than or equal to 800 umhos, which occurred in 47 percent of the samples. For specific conductance greater than 800 umhos, the water was chloride type. Generally, sodium did not make up 50 percent or more of the major cations for specific conductance greater than 800 umhos; however, it was the principal cation.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 253 mg/L and the water was very hard. Hardness concentrations were greater than 180 mg/L, very hard class, for 84 percent of the hardness values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 37 percent of the chloride values. No toxic element data were available. Because of the frequency of exceedence of the recommended maximum chloride concentration, this water might not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to high with 58 percent of the samples having a high salinity hazard. The sodium hazard was low class for all SAR values. No boron data were available.

07174700 - Caney River near Ochelata, Okla.--Continued

UNIVARIATE STATISTICS

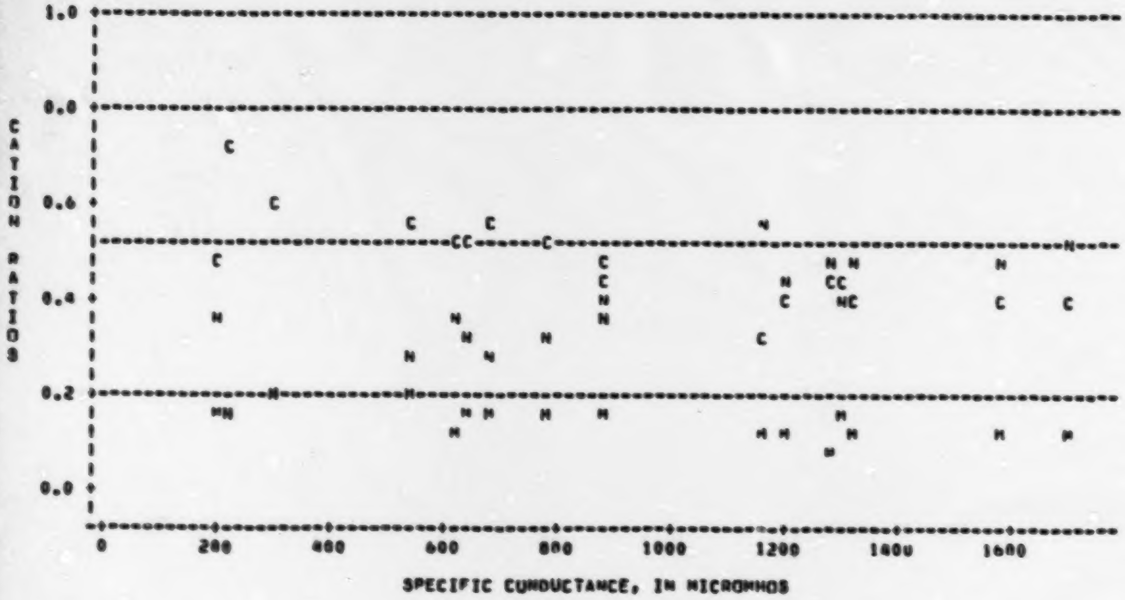
CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	19	886	205	1700	434	0.15	-0.69
Dissolved solids	17	546	127	1150	291	.28	-.50
pH	19	8.4	7.5	8.6	0.3	-1.74	2.92
Total hardness	19	253	60	410	96	-.33	-.28
Chloride	19	181	8.0	415	123	.39	-1.00
Sulfate	17	37	8.2	67	18	.12	-.93
Iron	0						
Fluoride	1	0.2					
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	17	2.2	0.4	4.2	1.2	.29	-1.29
Boron	0						

FREQUENCY DISTRIBUTION

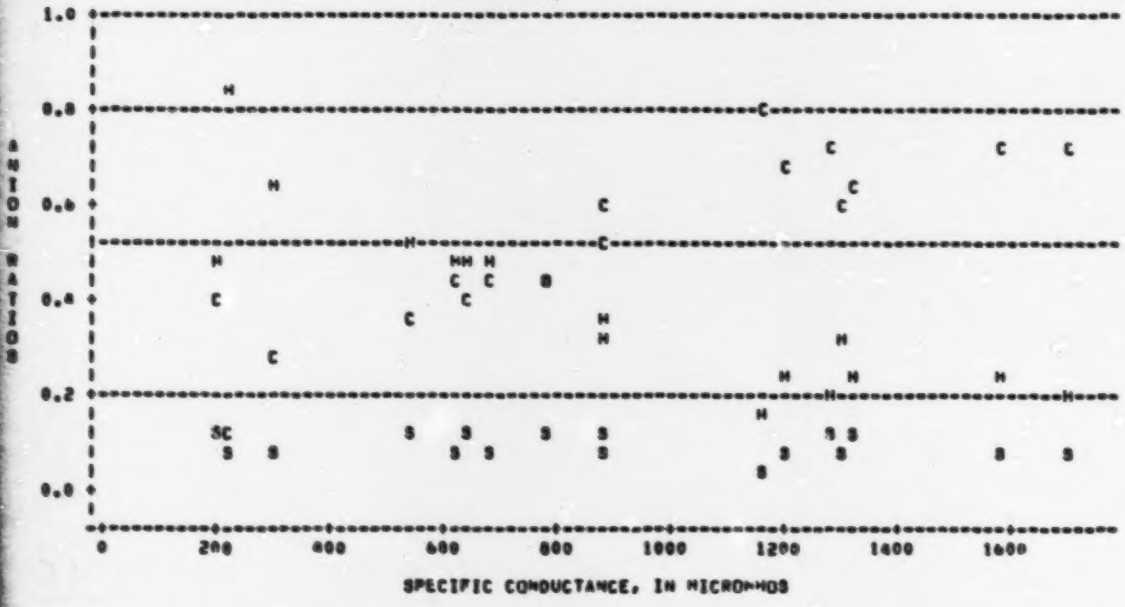
CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	223	600	819	1220	1336
Dissolved solids	131	320	496	782	841
pH	7.8	8.2	8.4	8.4	8.5
Total hardness	92	197	242	304	380
Chloride	25	85	152	278	334
Sulfate	10	23	34	45	63
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.6	1.1	1.7	3.2	3.8
Boron					

BEST DOCUMENT AVAILABLE

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER NR OCHELATA, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER NR OCHELATA, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,   C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER NR OCHELATA, OK
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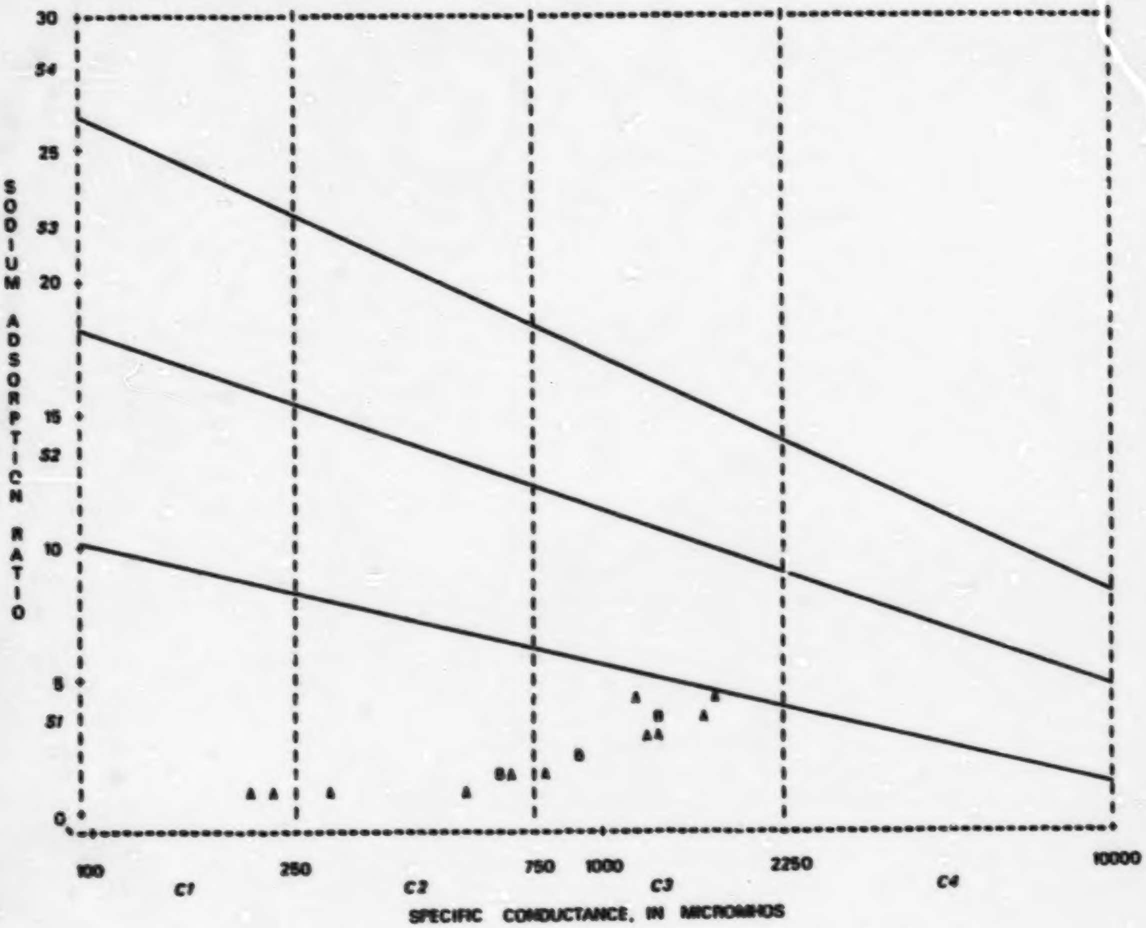


BEST DOCUMENT AVAILABLE

07175500 - Caney River near Ramona, Okla.

LOCATION.--Lat 36°30'31", long 95°50'36", in NE¼NW¼ sec.5, T.23 N., R.14 E., Washington County, at county road bridge, 1 mi upstream from Buck Creek, 2.2 mi downstream from Double Creek, 4.5 mi southeast of Ramona, and at mile 32.0.

DRAINAGE AREA.--1,955 mi^2.

PERIOD OF RECORD.--1952 to 1953, 1955 to 1962, 1965 to 1978.

WATER TYPE.--The water type was variable and depended on the specific conductance. For specific conductance less than or equal to 600 umhos, which occurred in 47 percent of the samples, the water was calcium carbonate/bicarbonate type. For specific conductance greater than 1,200 umhos, which occurred in 6 percent of the samples, the water was sodium chloride type. For the specific conductance range of 600 to 1,200 umhos, 47 percent of the samples, calcium was predominant from a specific conductance of 600 to 900 umhos. From 900 to 1,200 umhos, there was no predominant cation. Chloride predominated throughout the 600 to 1,200 umhos range. Therefore, in the specific conductance range of 600 to 900 umhos, the water was calcium chloride type.

TREND.--The plots of dissolved solids, hardness, sulfate, and chloride versus time indicated there was a possibility of decreasing trends. The Spearman's rhos showed for each of the four constituents a trend of decreasing concentration at the 95-percent probability level.

PUBLIC WATER SUPPLY.--The average hardness was 193 mg/L and the water was very hard. Hardness concentration were greater than 120 mg/L for 81 percent of the hardness values and greater than 180 mg/L, very hard class, for 53 percent of the values. The recommended minimum pH of 5.0 was exceeded by less than 0.5 percent of the pH values and the recommended maximum pH of 9.0 was exceeded by 2 percent of the pH values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 7 percent of the chloride values. No toxic element data were available. Because of the exceedence of recommended maximums by chloride and pH, this water might not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to very high with 33 percent of the samples in the high or very high salinity hazard class. The sodium hazard ranged from low to medium with more than 99 percent of the SAR values in the low sodium hazard class. The data indicate there should be no effects from boron phytotoxicity.

07175500 - Caney River near Ramona, Okla.--Continued

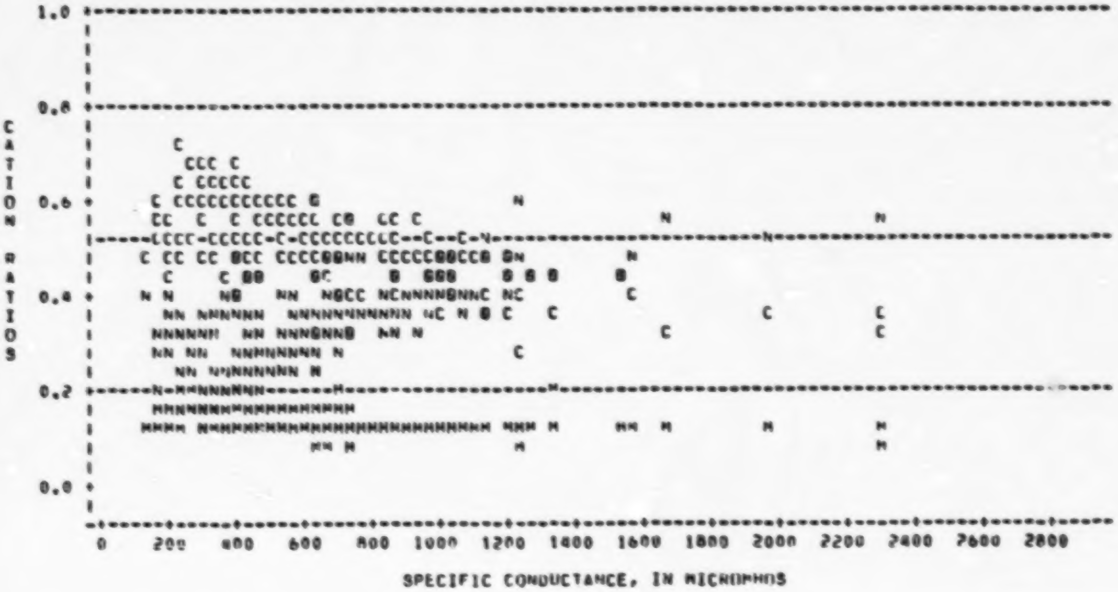
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	701	670	127	2310	335	1.16	2.21
Dissolved solids	612	400	7	1380	200	1.23	2.33
pH	684	8.0	3.0	9.9	0.6	-2.41	19.33
Total hardness	621	193	41	490	76	.34	-.07
Chloride	665	118	8.3	610	91	1.67	3.88
Sulfate	610	32	2.1	112	15	1.41	3.36
Iron	0						
Fluoride	9	0.5	0.2	0.9			
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	602	1.7	0.3	5.7	0.9	1.14	1.60
Boron	2	135	70	200			

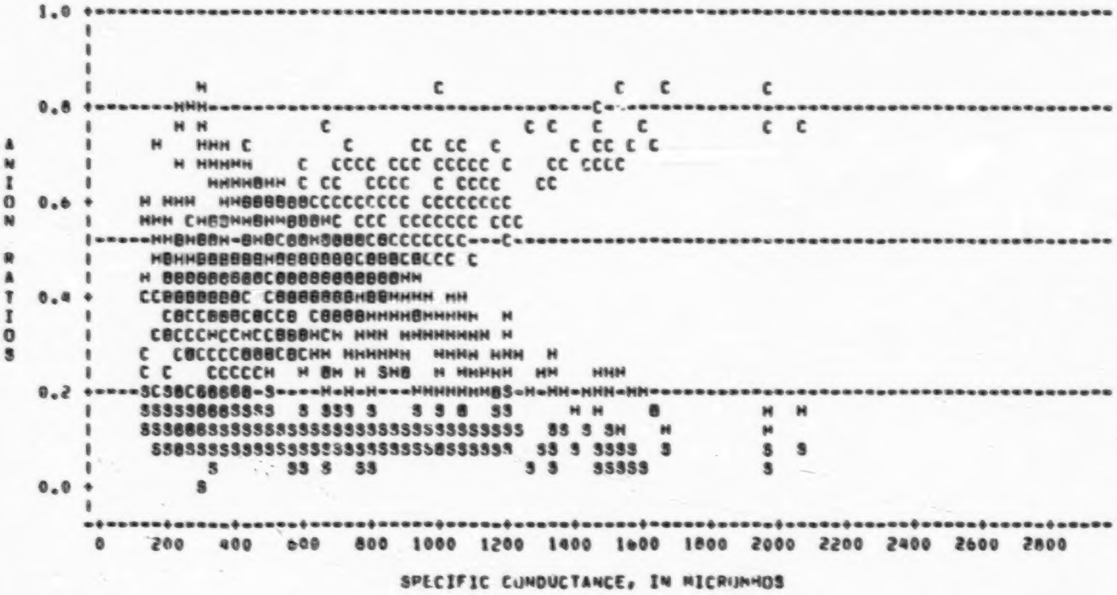
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	298	415	614	850	1104
Dissolved solids	183	247	367	508	652
pH	7.4	7.7	8.0	8.3	8.5
Total hardness	95	138	189	240	297
Chloride	31	50	95	160	230
Sulfate	16	21	30	39	49
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.8	1.0	1.5	2.2	2.9
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER NR RAMONA, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER NR RAMONA, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,  C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER NR RAMONA, OK
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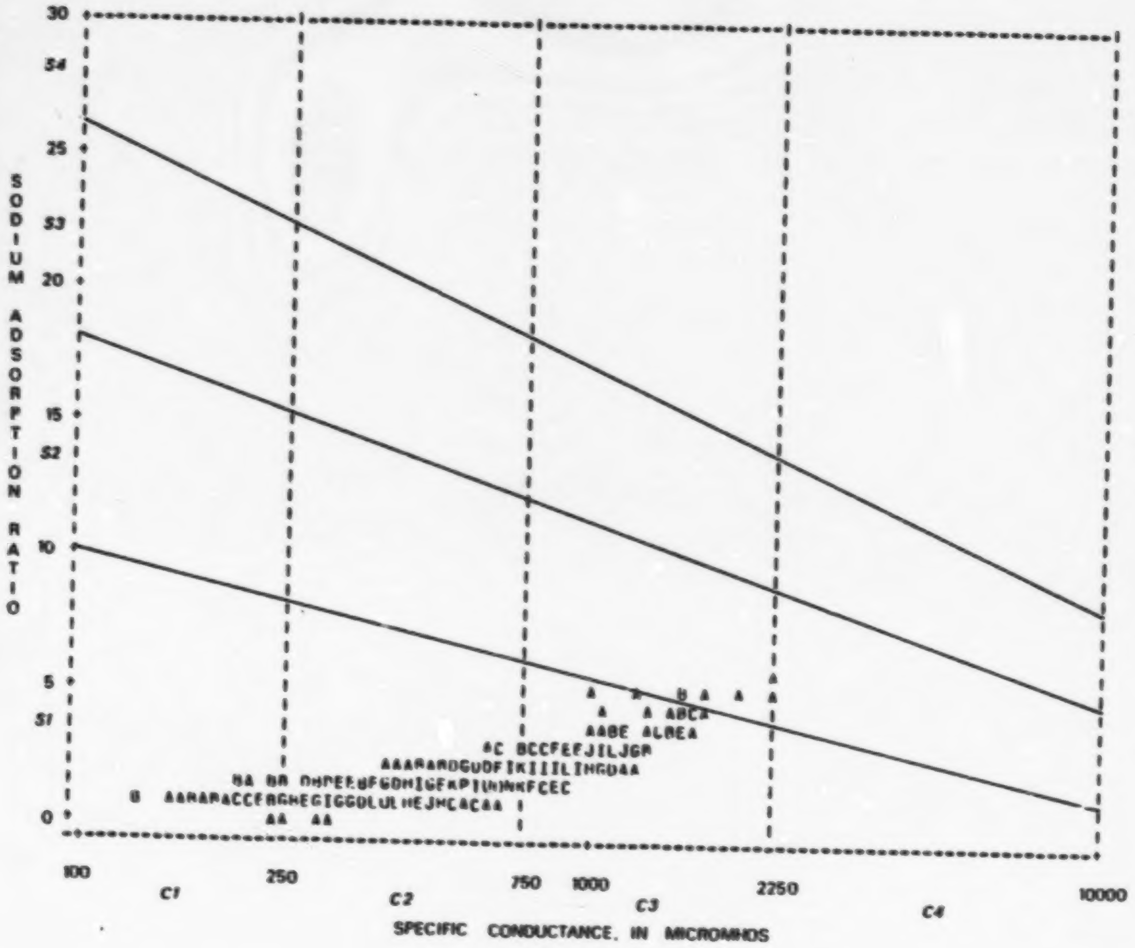


VERDIGIRS RIVER BASIN

07175550 - Caney River near Collinsville, Okla.

LOCATION.--Lat 36°23'42", long 95°48'42", in SW¼SW¼ sec.10, T.22 N., R.14 E., Tulsa County, at bridge on U.S. Highway 169, 3.0 mi northeast of Collinsville, and at mile 15.8.

DRAINAGE AREA.--2,046 mi^2.

PERIOD OF RECORD.--1949 to 1953, 1959.

WATER TYPE.--The water type was variable and depended on the specific conductance. For specific conductance less than 600 umhos, which occurred in 36 percent of the samples, the water was calcium bicarbonate type. For specific conductance greater than 600 umhos, chloride was predominant. The data were inadequate to determine whether any cation was predominant at the larger specific conductances. Data from upstream stations along with the data from this station indicate the water might change to sodium chloride type as the specific conductance increases.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 231 mg/L and the water was very hard. Hardness concentrations were greater than 180 mg/L, very hard class, for 70 percent of the hardness values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 3 percent of the chloride values. No toxic element data were available. Based on the data, this water should be suitable for use as a public supply; however, chloride concentrations should be monitored.

IRRIGATION.--The salinity hazard ranged from low to high, with 47 percent of the samples having a salinity hazard in the high class. The sodium hazard was low class for all SAR values. No boron data were available.

07175550 - Caney River near Collinsville, Okla.--Continued

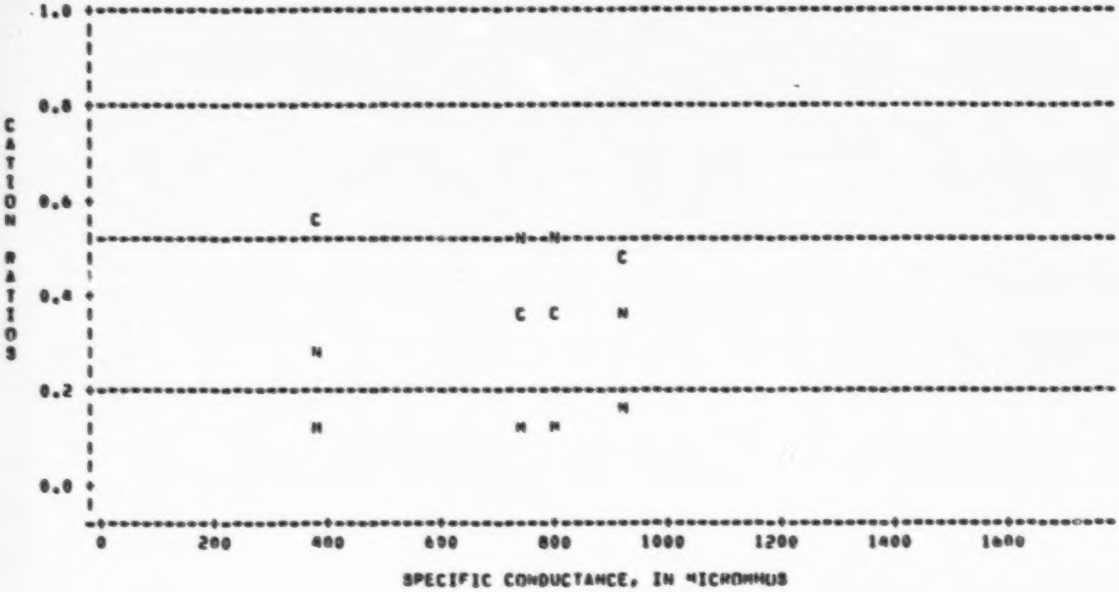
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	30	749	246	1630	322	0.72	0.61
Dissolved solids	25	487	132	1000	194	.52	.85
pH	22	7.4	7.1	8.1	0.3	.64	-.24
Total hardness	30	231	86	472	90	.72	1.00
Chloride	30	121	22	305	72	.72	-.40
Sulfate	25	39	16	91	18	1.42	2.68
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	12	2.1	0.9	3.6	0.8	.05	-.28
Boron	0						

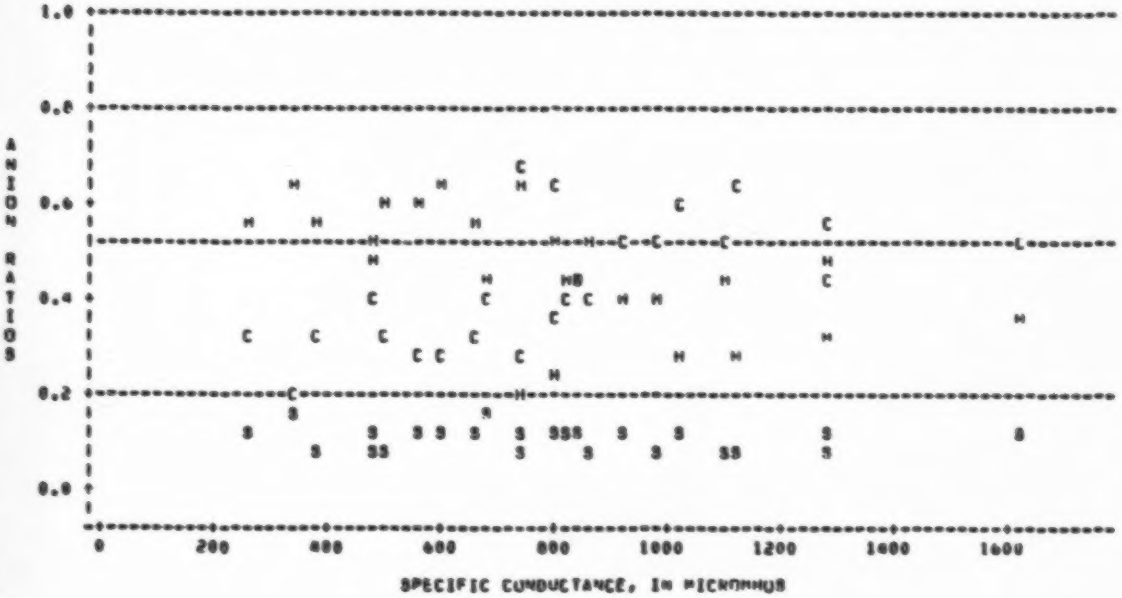
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	340	493	741	884	1130
Dissolved solids	224	314	475	588	704
pH	7.3	7.4	7.4	7.7	7.9
Total hardness	116	162	240	275	304
Chloride	36	61	113	169	210
Sulfate	17	28	36	44	56
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.5	1.6	2.0	2.6	2.9
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER NR COLLINSVILLE, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER NR COLLINSVILLE, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=CANEY RIVER NR COLLINSVILLE, OK
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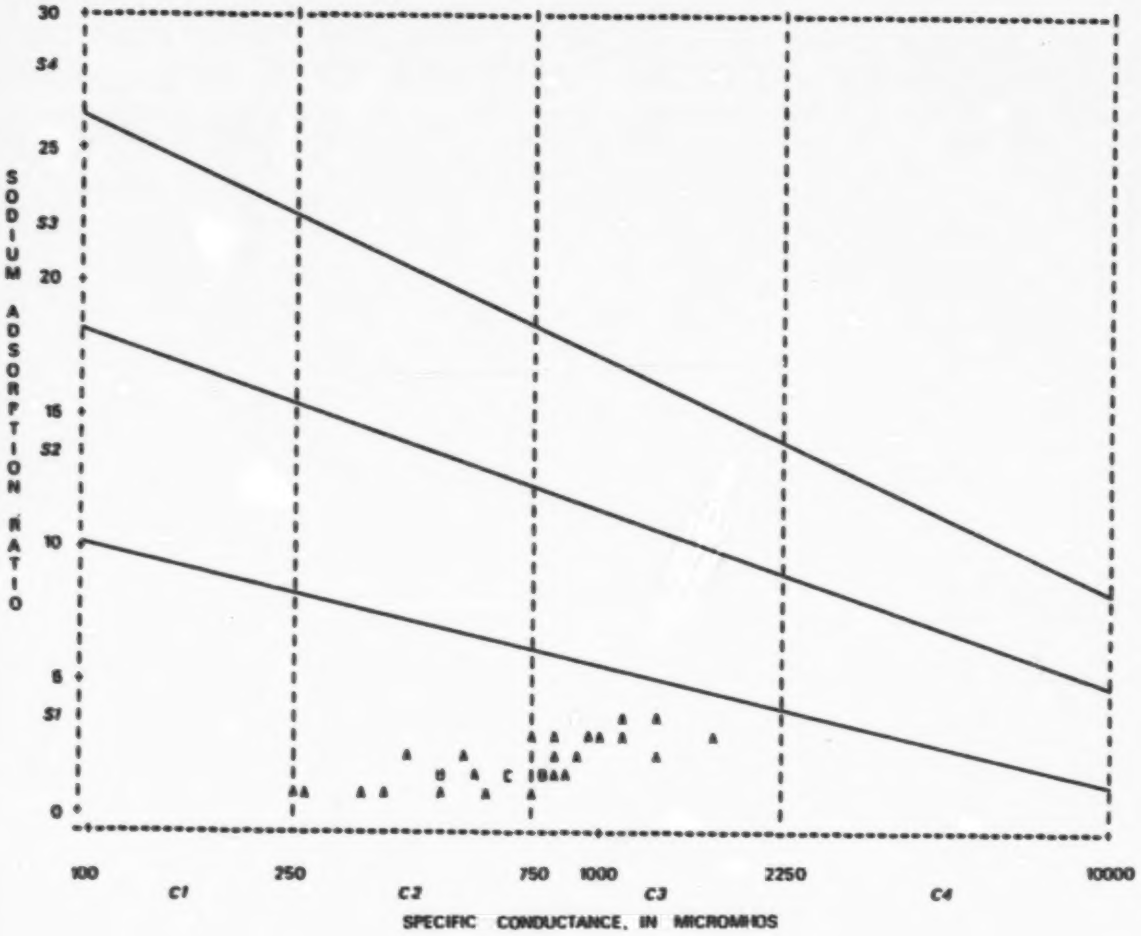


BEST DOCUMENT AVAILABLE

VERDIGRIS RIVER BASIN

07174150 - Cotton Creek near Copan, Okla.

LOCATION.--Lat 36°56'20", long 95°55'00", in NE¼SE¼ sec.4, T.28 N., R.13 E., Washington County, at bridge on U.S. Highway 75, 0.8 mi downstream from North Fork, and 2.8 mi north of Copan.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1952 to 1953, 1967 to 1968.

WATER TYPE.--The water at this location was chloride type. The data were insufficient to construct a cation ratio plot. The data indicate sodium is probably the predominant cation, and the water is most likely to be sodium chloride type, particularly as the specific conductance increases.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 726 mg/L and the water was very hard. More than 90 percent of the hardness values were greater than 180 mg/L, very hard class. The recommended maximum chloride concentration of 250 mg/L was exceeded by 88 percent of the chloride values. No toxic element data were available. Because of the frequency and magnitude by which the recommended maximum chloride concentration was exceeded, this water would not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from medium to very high with 82 percent of the samples having a very high salinity hazard, specific conductance greater than 2,250 umhos. The sodium hazard ranged from low to very high with approximately 55 percent of the SAR values in the high or very high sodium hazard classes. No boron data were available.

UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	34	4804	478	11600	2930	0.57	-0.26
Dissolved solids	11	2983	294	5650	1675	.08	-.77
pH	34	7.9	7.0	8.4	0.3	-1.05	.59
Total hardness	11	726	90	1460	383	.37	.17
Chloride	34	1484	84	3900	1002	.70	-.14
Sulfate	10	54	23	89	20	.06	-.59
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	11	10	2.5	18	4.8	-.20	-.56
Boron	0						

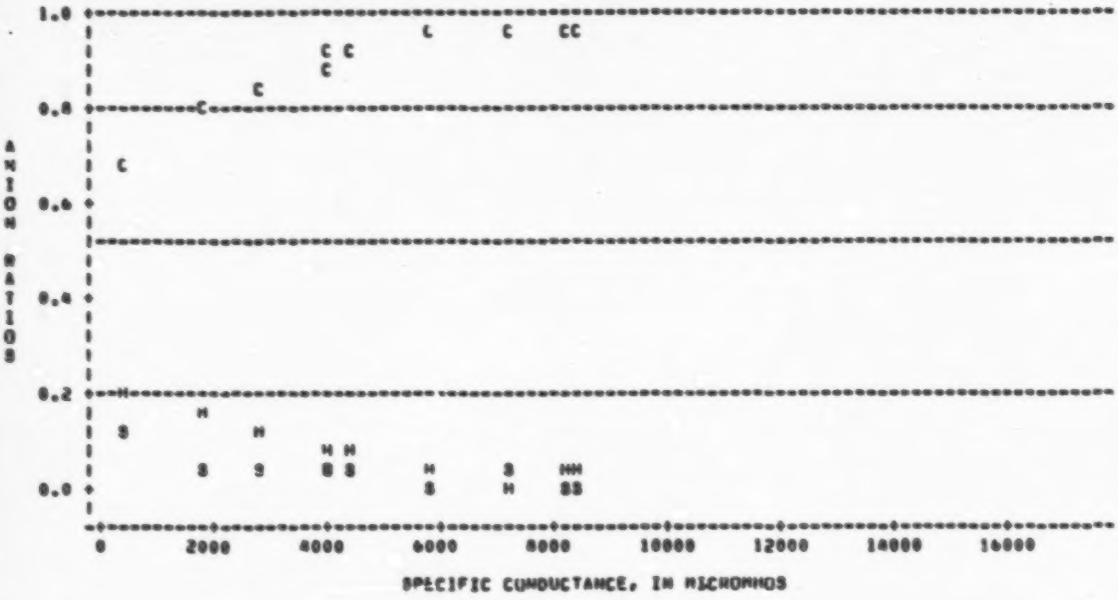
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	809	2785	4100	7055	8308
Dissolved solids	373	1492	2657	3843	5032
pH	7.2	7.7	7.9	8.1	8.2
Total hardness	121	428	648	925	1105
Chloride	181	772	1200	2225	2770
Sulfate	23	34	58	62	75
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	2.6	5.7	9.7	13	15
Boron					

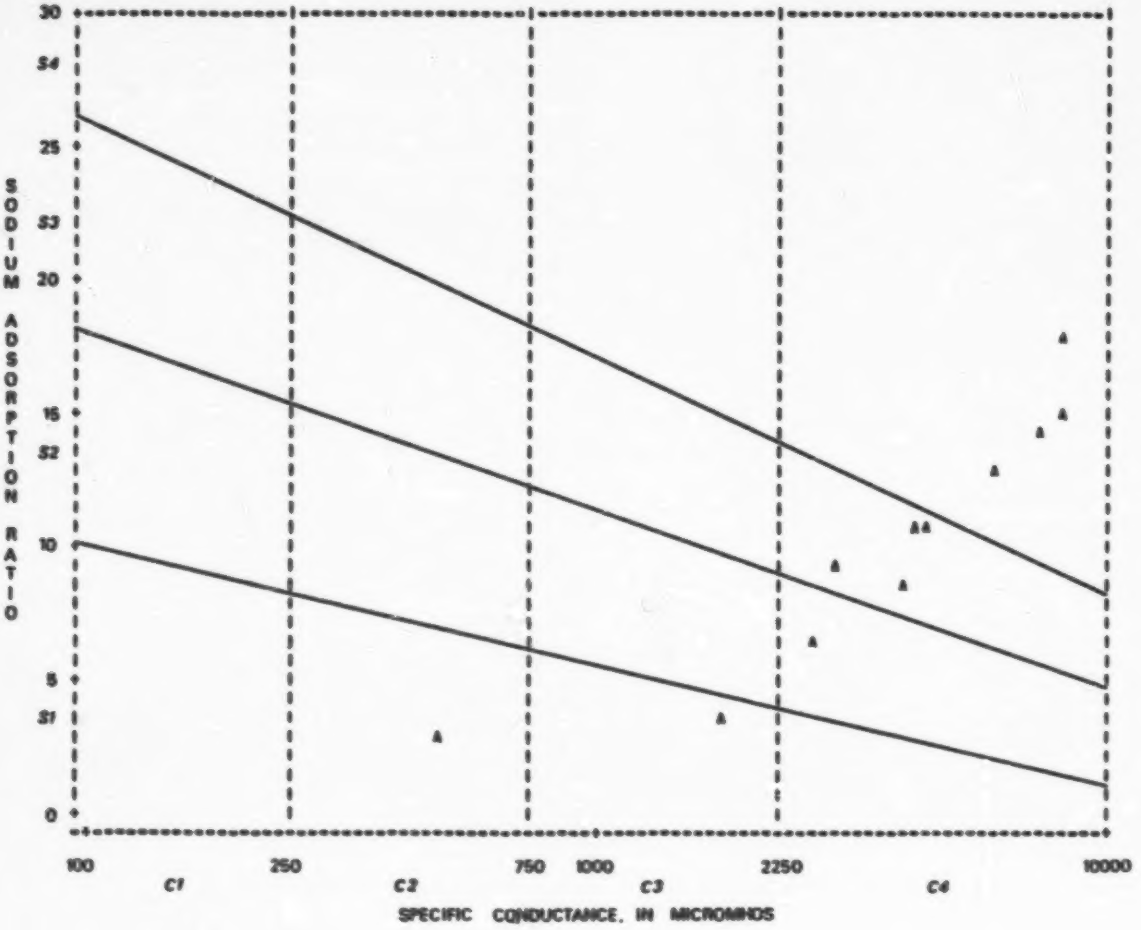
BEST DOCUMENT AVAILABLE

No cation distribution data are available.

ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=COTTON CREEK NR COPAN, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,   C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,   B = 2 OBS,   C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=COTTON CREEK NR COPAN, OK



VERDIGRIS RIVER BASIN

07176770 - Hominy Creek near Hominy, Okla.

LOCATION.--Lat 36°28'24", long 96°22'45", in SW¼NE¼ sec.18, T.23 N., R.9 E., Osage County, at bridge on State Highway 99, 4.5 mi north of Hominy.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1950 to 1953, 1956, 1965 to 1966.

WATER TYPE.--The water was chloride type for all measured specific conductances. Sodium was predominant when the specific conductance was greater than 1,600 umhos, which occured in 50 percent of the samples. For specific conductance of 1,600 umhos or less, no cation ratio was 50 percent or more. For specific conductance greater than 1,600 umhos, the water was sodium chloride type and was mixed cation-chloride type for smaller specific conductances.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 380 mg/L and the water was very hard. All of the hardness values were greater than 180 mg/L, very hard class. The recommended maximum chloride concentration of 250 mg/L was exceeded by 56 percent of the chloride values. No toxic element data were available. Because of the frequency and magnitude by which the recommended maximum chloride concentration was exceeded, this water would not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from medium to very high with 89 percent of the samples having a high or very high salinity hazard, that is, specific conductance greater than 750 umhos. The sodium hazard ranged from low to very high with approximately 65 percent of the SAR values in the low sodium hazard class. No boron data were available.

07176770 - Hominy Creek near Hominy, Okla.--Continued

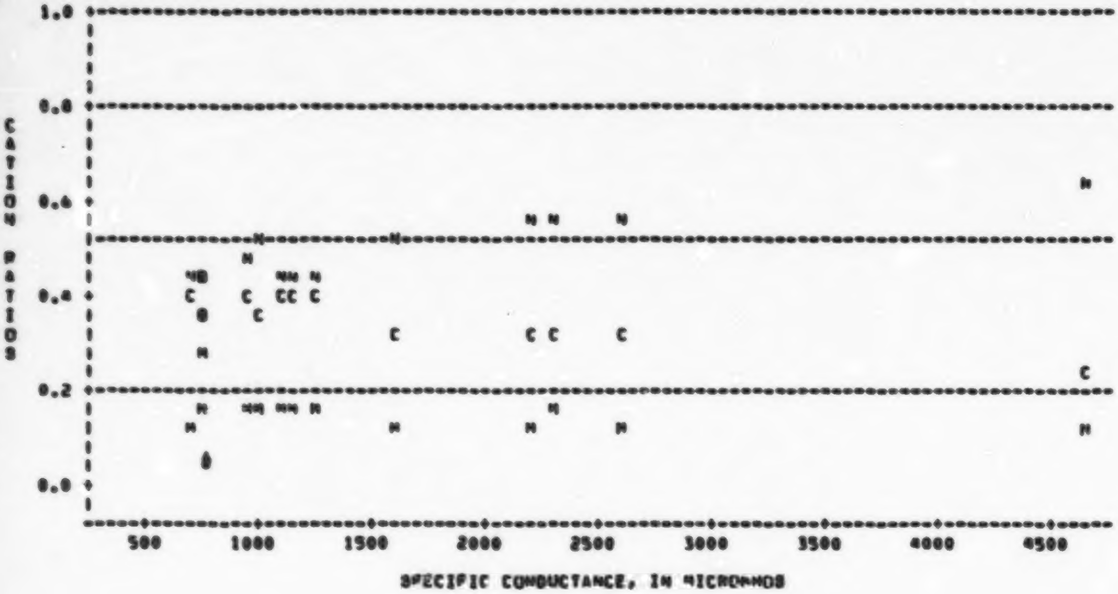
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	18	1730	700	4660	1048	1.45	2.32
Dissolved solids	18	1104	417	2710	625	1.14	1.08
pH	11	7.8	7.2	8.1	0.3	-.55	-.50
Total hardness	18	380	185	788	163	.89	.63
Chloride	18	445	118	1460	349	1.67	3.14
Sulfate	17	27	15	45	8.3	.56	-.34
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	14	4.0	1.7	10	2.3	1.47	2.53
Boron	0						

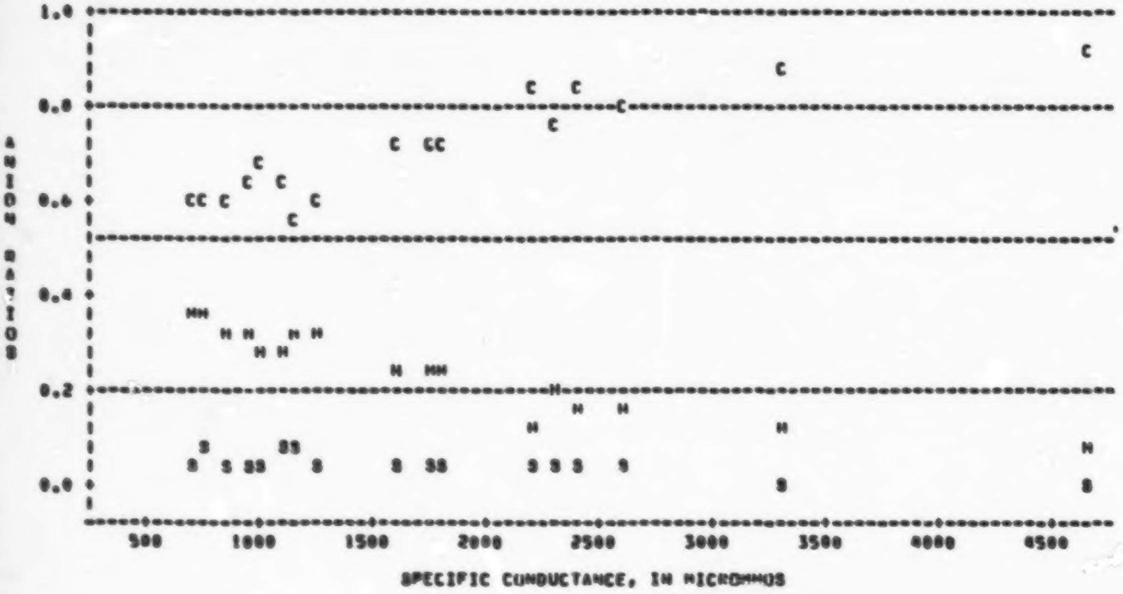
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	724	910	1240	2255	2756
Dissolved solids	429	609	922	1355	1822
pH	7.2	7.4	7.8	7.9	7.9
Total hardness	192	232	338	462	571
Chloride	136	190	260	590	772
Sulfate	16	20	25	32	37
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	1.9	2.4	2.8	5.5	5.8
Boron					

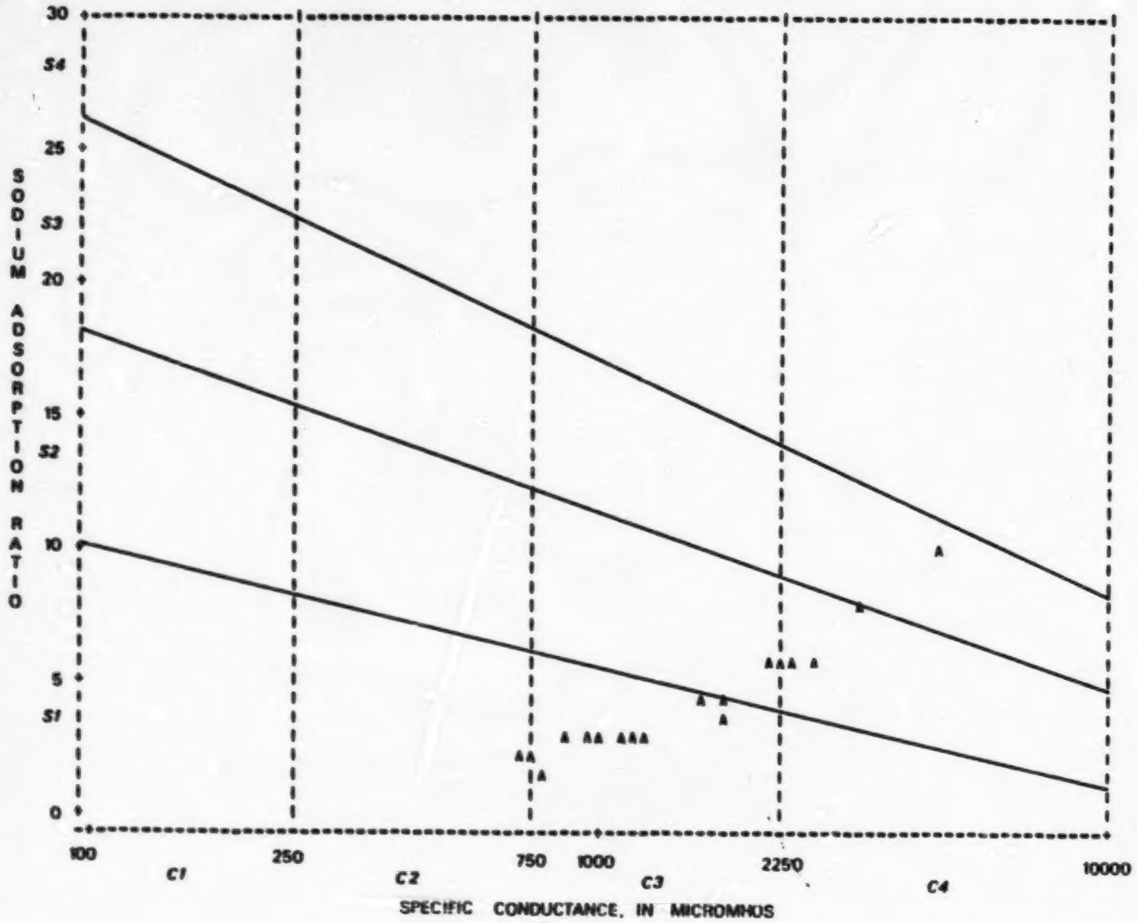
CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=HOMINY CREEK NR HOMINY, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=HOMINY CREEK NR HOMINY, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=HOMINY CREEK NR HOMINY, OK



07177000 - Hominy Creek near Skiatook, Okla.

LOCATION.--Lat 36°20'55", long 96°06'35", in SW¼SE¼ sec.27, T.22 N., R.11 E., Osage County, at bridge on State Highway 20, 1.0 mi upstream from Tall Chief Creek, 6.0 mi west of Skiatook, and at mile 16.7

DRAINAGE AREA.--340 mi^2.

PERIOD OF RECORD.--1948 to 1953, 1965 to 1966.

WATER TYPE.--The water was generally sodium chloride type. For specific conductance less than 300 umhos, which occurred in only 9 percent of the samples, sodium did not predominate. Chloride was predominant throughout the range of measured specific conductance.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 222 mg/L and the water was very hard. Hardness concentrations were greater than 120 mg/L for 70 percent of the hardness values and greater than 180 mg/L for 50 percent of the values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 35 percent of the chloride values. No toxic element data were available. Because of the frequency and magnitude by which the recommended maximum chloride concentration was exceeded, this water may not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to high with 54 percent of the samples in the high salinity hazard class. The sodium hazard ranged from low to medium with less than 10 percent of the SAR values in the medium sodium hazard class. No boron data were available.

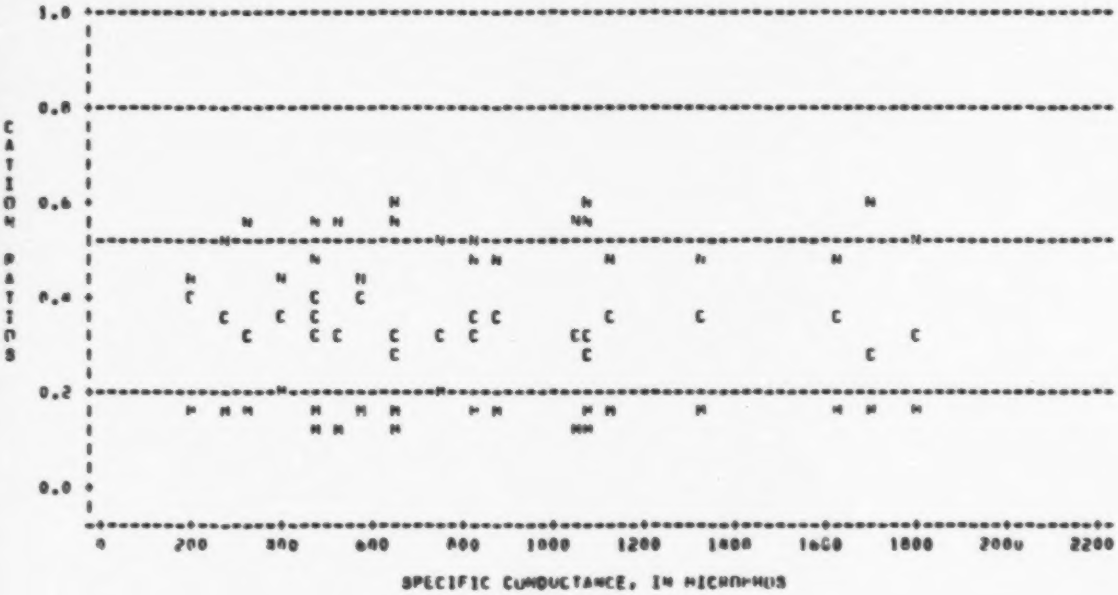
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	34	935	211	2200	537	0.81	-0.27
Dissolved solids	22	602	222	1250	316	.84	-.56
pH	25	7.5	6.8	8.2	0.3	-.03	.26
Total hardness	34	222	54	577	133	.78	-.20
Chloride	34	209	32	605	148	1.16	.51
Sulfate	22	21	8.8	53	9.5	1.88	5.47
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	26	2.7	1.1	5.0	1.0	.46	-.32
Boron	0						

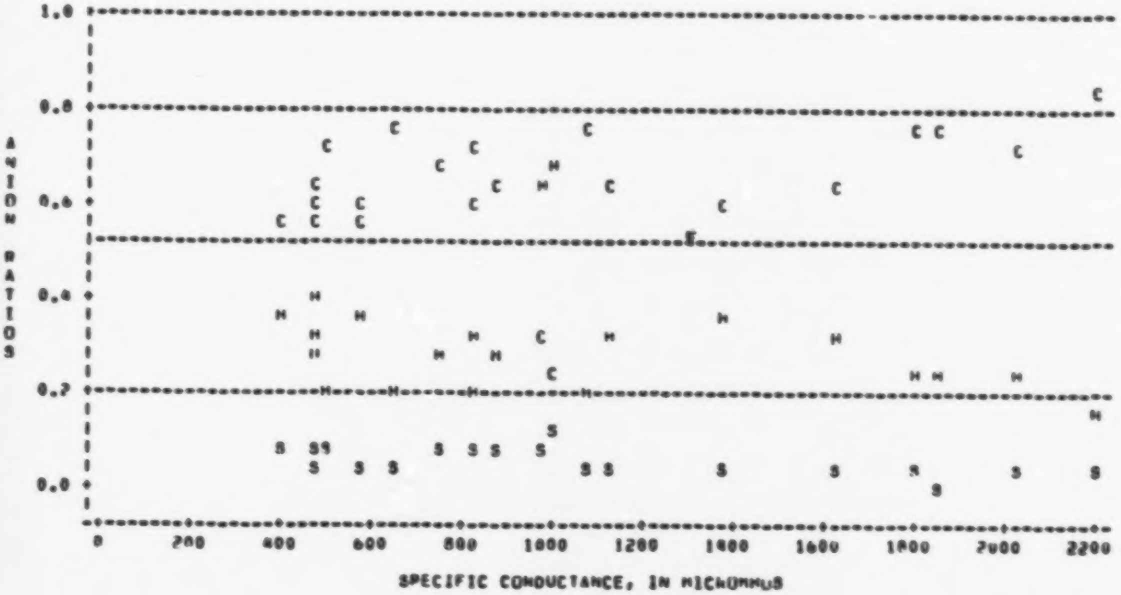
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	357	478	820	1200	1760
Dissolved solids	287	331	491	744	1107
pH	7.0	7.3	7.5	7.6	8.0
Total hardness	74	116	178	323	402
Chloride	72	94	151	269	459
Sulfate	10	16	17	24	28
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	1.4	1.8	2.6	3.4	4.0
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=HOMINY CREEK NR SKIATOOK, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=HOMINY CREEK NR SKIATOOK, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,   B = 2 OBS,   C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=HOMINY CREEK NR SKIATOOK, OK
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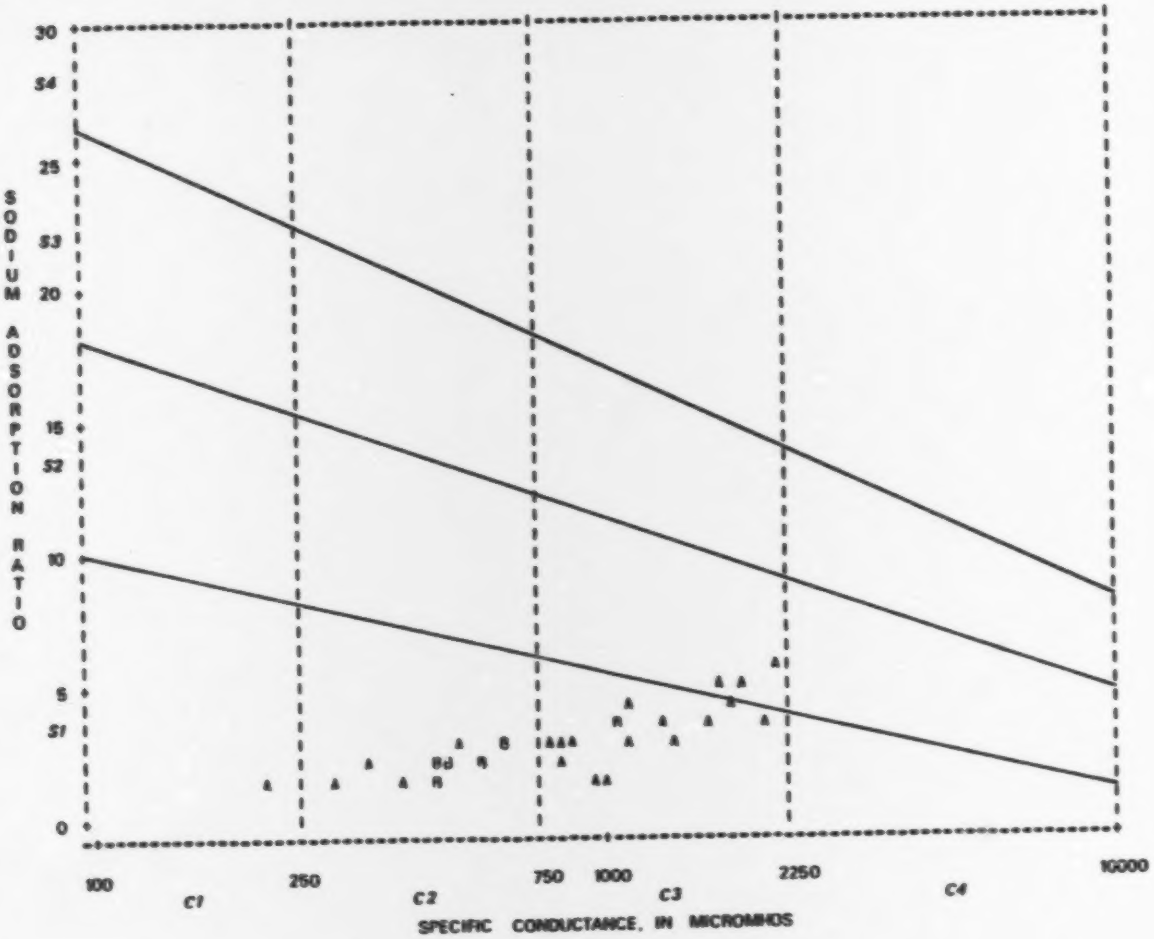


VERDIGRIS RIVER BASIN

07171240 - Lightning Creek near Alluwe, Okla.

LOCATION.--Lat 36°38'54", long 95°29'06", in SE¼NE¼ sec.16, T.25 N., R.17 E., Nowata County, at bridge on State Highway 28, 2.5 mi north of Alluwe.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1952 to 1953, 1959.

WATER TYPE.--The water was generally calcium type. The calcium ratio was equal to or greater than 50 percent for specific conductances 1,200 umhos or less, which occurred in 80 percent of the samples. For specific conductance greater than 1,200 umhos, the chloride ion was predominant, however, there was insufficient data to determine predominance of any cation at larger specific conductances.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 382 mg/L and the water was very hard. More than 90 percent of the hardness values were greater than 180 mg/L, very hard class. The recommended maximum chloride concentration of 250 mg/L was exceeded by 19 percent of the chloride values. No toxic element data were available. Because of the magnitude by which the recommended maximum chloride concentration was exceeded, this water would not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from medium to very high with 57 percent of the samples having a salinity hazard in the high or very high calsses, specific conductance greater than 750 umhos. The sodium hazard ranged from low to very high with 80 percent of the SAR values in the low sodium hazard class. Data indicate that phytotoxicity effects from boron should not occur.

07171240 - Lightning Creek near Alluwe, Okla.--Continued

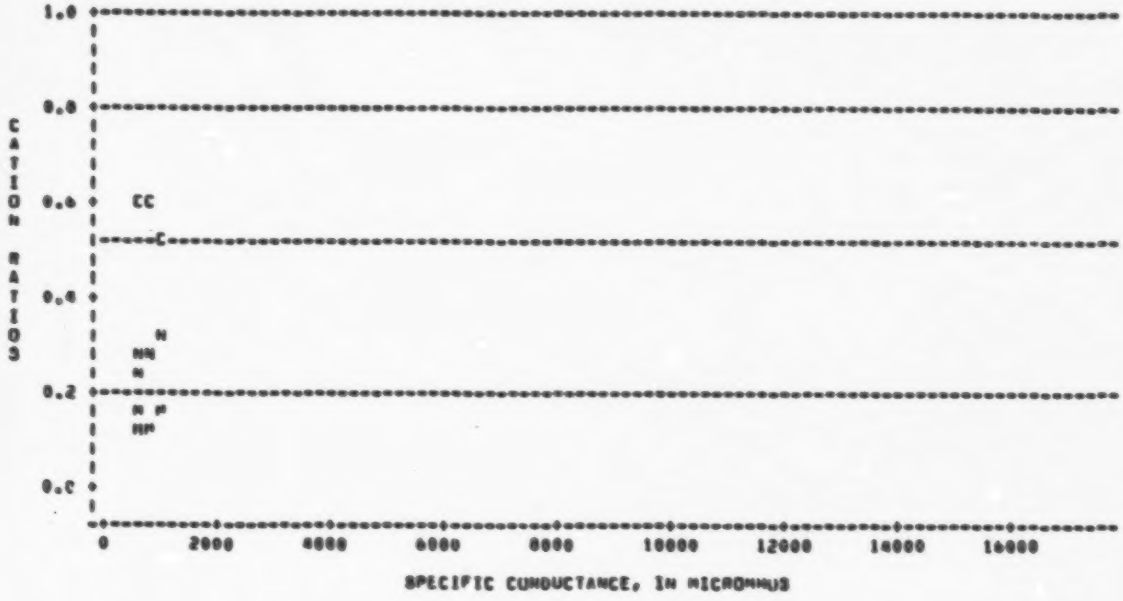
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	21	1854	388	11700	2753	2.83	8.25
Dissolved solids	15	1419	328	7190	1927	2.35	5.49
pH	21	7.6	7.0	8.0	0.3	-.55	-.43
Total hardness	21	382	164	1370	291	2.49	6.42
Chloride	21	475	28	3960	959	2.93	8.90
Sulfate	15	94	67	155	25	.87	.97
Iron	0						
Fluoride	3	0.3	0.3	0.4			
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	13	5.0	0.5	24	7.4	1.87	2.65
Boron	2	115	70	160			

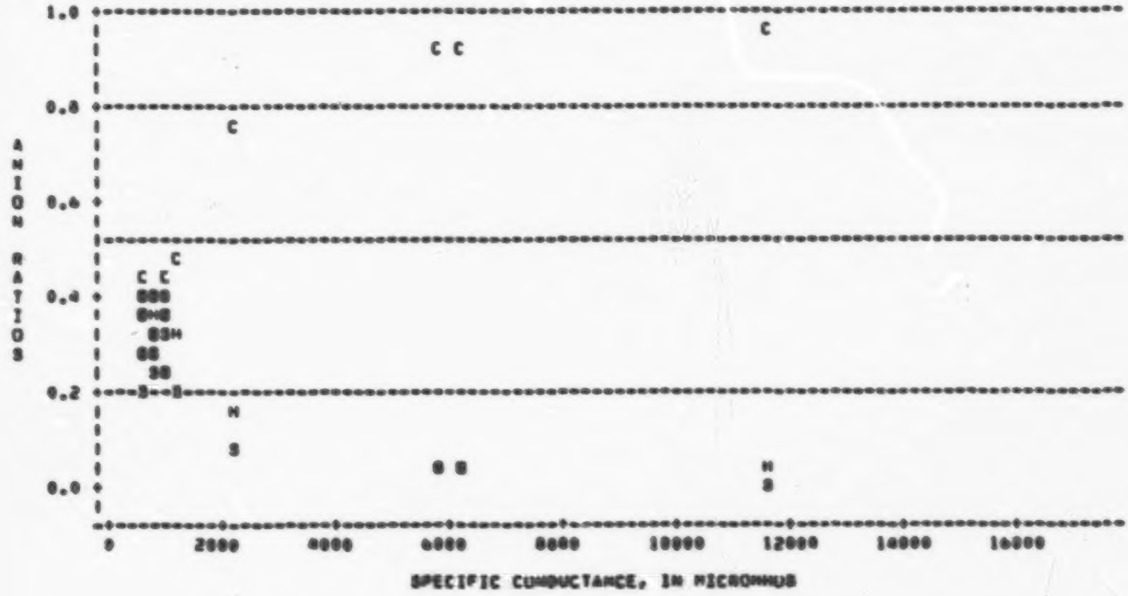
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	466	655	818	1027	5416
Dissolved solids	351	423	546	857	3595
pH	7.1	7.3	7.6	7.8	7.9
Total hardness	172	216	278	372	750
Chloride	51	71	114	160	1676
Sulfate	50	69	94	106	114
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.6	1.0	1.3	1.9	12
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=LIGHTNING CREEK NR ALLUWE, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=LIGHTNING CREEK NR ALLUWE, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LUCAL IDENTIFIER=LIGHTNING CREEK NR ALLUWE, OK
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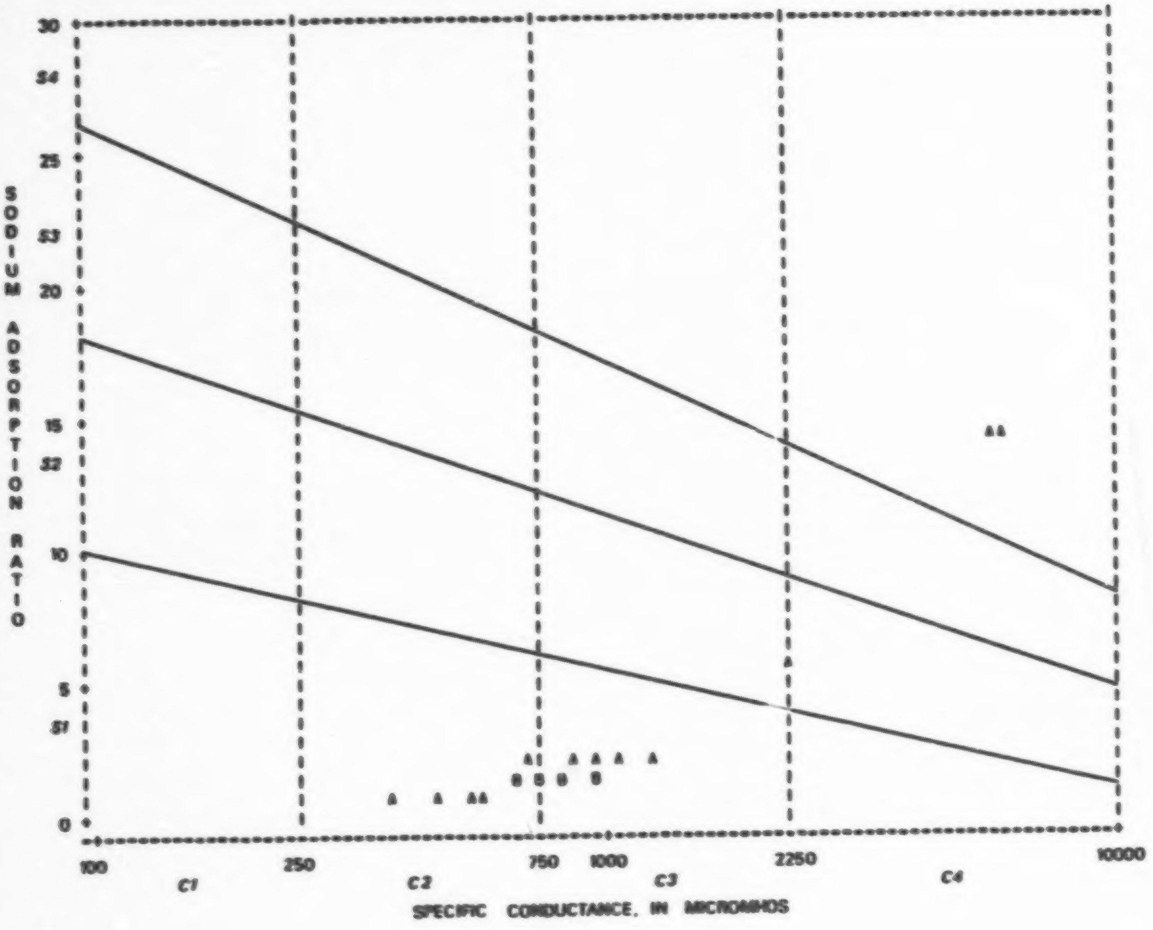


BEST DOCUMENT AVAILABLE

VERDIGRIS RIVER BASIN

07174200 - Little Caney River below Cotton Creek, near Copan, Okla.

LOCATION.--Lat 36°53'42", long 95°58'09", in W½ sec.19, T.28 N., R.13 E., Washington County, at bridge on State Highway 10, 2 mi west of Copan, 4.2. mi downstream from Cotton Creek, and at mile 8.8.

DRAINAGE AREA.--502 mi^2.

PERIOD OF RECORD.--1967 to 1968, 1976 to 1978.

WATER TYPE.--The water type varied with the specific conductance. The water was sodium chloride type for specific conductance greater than 500 umhos, which occurred in 68 percent of the samples. For specific conductance less than or equal to 500 umhos, the water was sodium carbonate/bicarbonate type.

TREND.--The current period of record was insufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 199 mg/L and the water was very hard. Hardness concentrations were greater than 180 mg/L, very hard class, for 52 percent of the hardness values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 15 percent of the chloride values. No toxic element data were available. Because of the frequency and magnitude by which the recommended maximum chloride concentration was exceeded, the suitability of this water for use as a public supply may be questionable.

IRRIGATION.--The salinity hazard ranged from low to very high with 38 percent of the samples having a high or very high salinity hazard. The sodium hazard ranged from low to medium with approximately 95 percent of the SAR values in the low sodium hazard class. The data indicate that no phytotoxicity effects from boron should occur.

07174200 - Little Caney River below Cotton Creek near Copan, Okla.--Continued

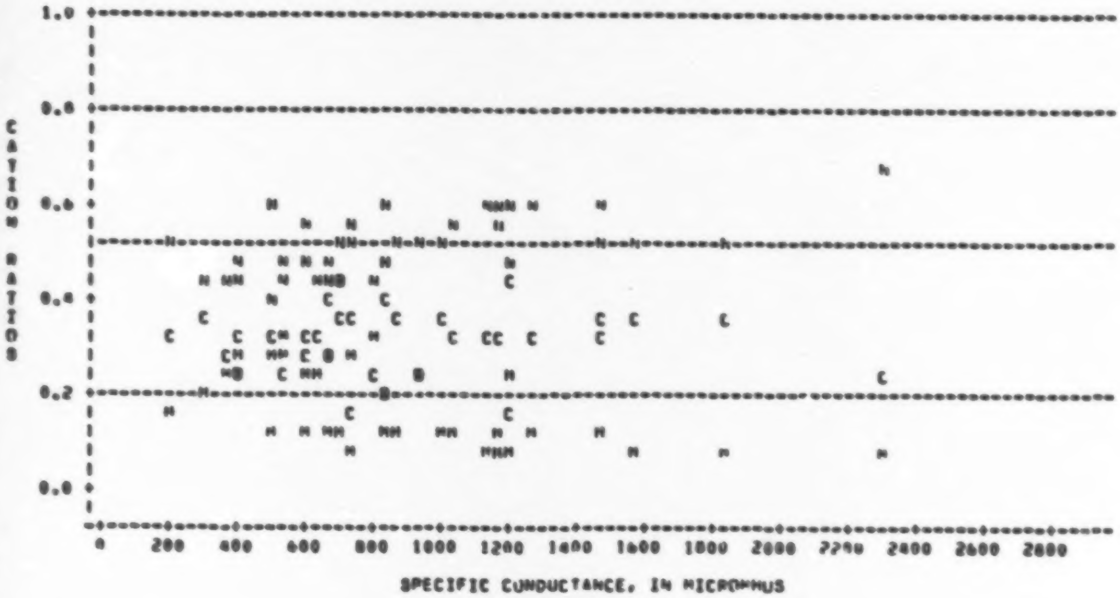
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	154	755	138	2960	458	1.93	5.16
Dissolved solids	113	502	76	1890	313	1.94	4.74
pH	134	8.0	5.7	8.6	0.4	-1.04	1.33
Total hardness	124	199	38	520	87	.90	1.32
Chloride	134	153	6.0	830	140	2.62	6.38
Sulfate	120	26	1.0	83	14	1.29	2.79
Iron	0						
Fluoride	38	0.3	0.2	0.5	0.1	.23	-.10
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	93	2.7	0.7	8.0	1.4	1.43	2.58
Boron	35	98	40	200	43	.52	-.62

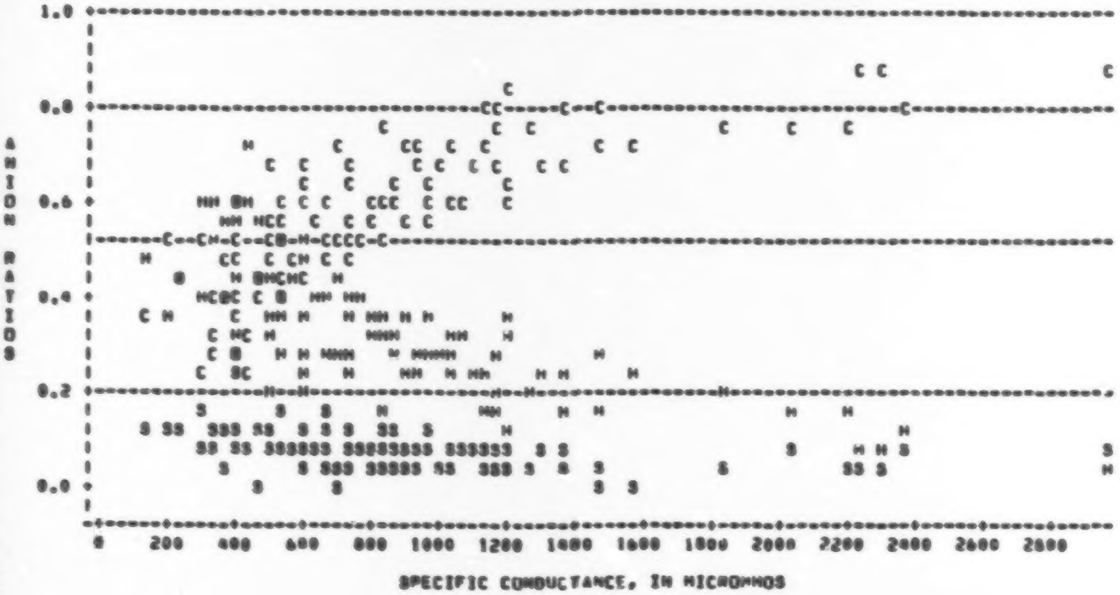
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	337	437	672	909	1197
Dissolved solids	218	300	425	606	808
pH	7.4	7.8	8.0	8.2	8.4
Total hardness	98	136	189	243	303
Chloride	36	58	114	204	302
Sulfate	11	17	23	33	44
Iron					
Fluoride	0.2	0.3	0.3	0.3	0.4
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	1.1	1.5	2.4	3.3	4.2
Boron	42	55	82	130	150

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=LITTLE CANEY RIVER BLW COTTON CR, NR COPAN, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=LITTLE CANEY RIVER BLW COTTON CR, NR COPAN, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=LITTLE CANEY RIVER BLW COTTON CR, NR COPAN, OK
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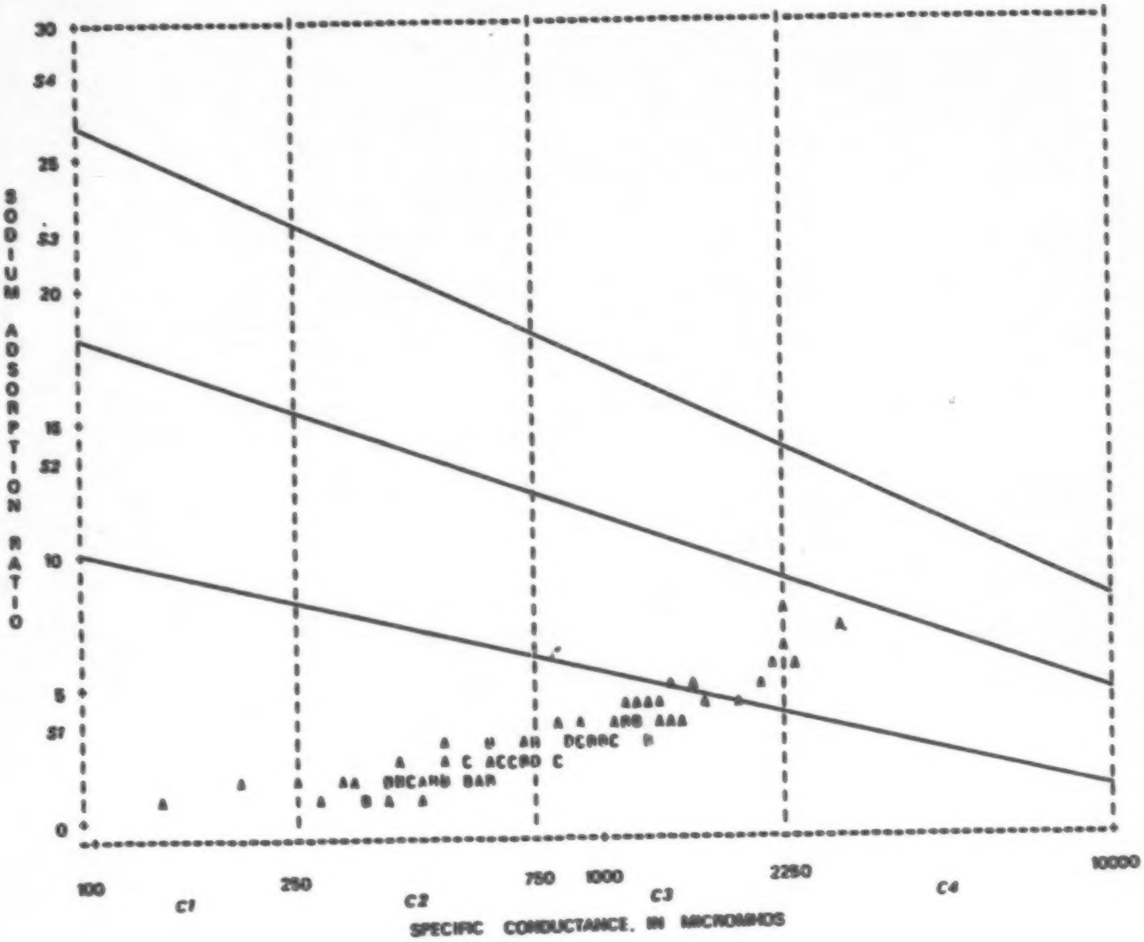


BEST DOCUMENT AVAILABLE

07171230 - Salt Creek near Alluwe, Okla.

LOCATION.--Lat 36°40'44", long 95°29'12", in SW¼NE¼ sec.4, T.25 N., R.17 E., Nowata County, at bridge on State Highway 28, 4.7 mi north of Alluwe.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1952 to 1953, 1959.

WATER TYPE.--Data at this location were inadequate to determine the relationship between water type and specific conductance. The data indicate that for specific conductance of 800 umhos or less, the water was calcium bicarbonate type. For specific conductance greater than 800 umhos, the water appears to shift to chloride type. Cation data were not available for specific conductance greater than 800 umhos.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 233 mg/L and the water was very hard. Hardness concentrations were greater than 180 mg/L, very hard class, for 55 percent of the hardness values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 10 percent of the chloride values. No toxic element data were available. Because of the magnitude by which the recommended maximum chloride concentration was exceeded, this water may not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to very high with 85 percent of the samples in the low or medium salinity hazard classes. The sodium hazard ranged from low to high with about 85 percent of the SAR values in the low sodium hazard class. The data indicate no phytotoxicity effects from boron should occur.

07171230 - Salt Creek near Alluwe, Okla.--Continued

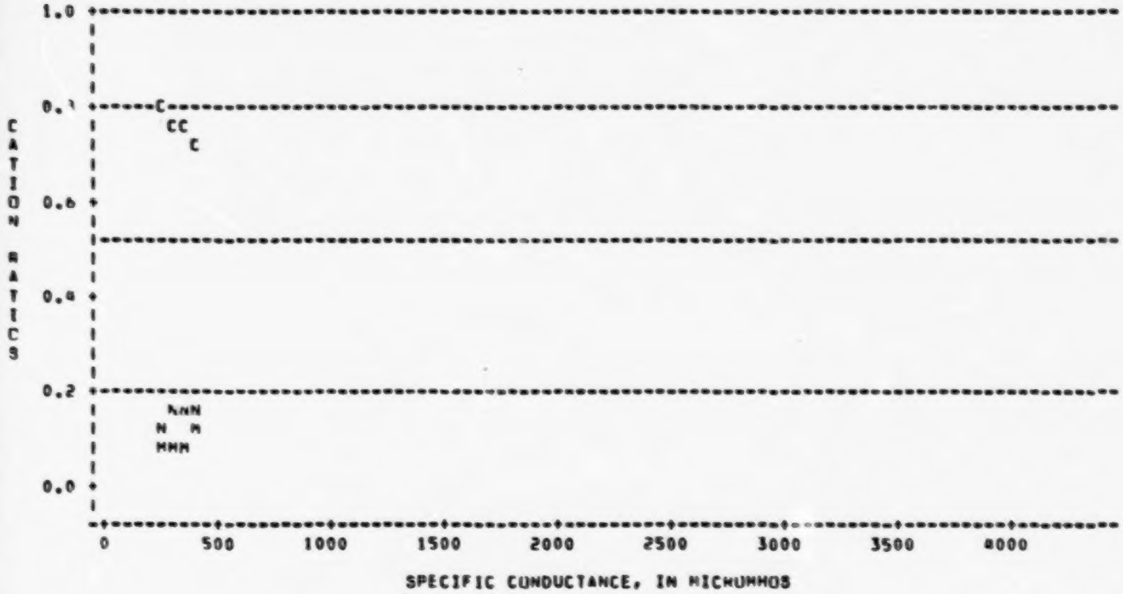
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	20	763	182	4190	1073	2.83	7.11
Dissolved solids	20	462	149	2480	629	2.86	7.24
pH	20	7.6	7.0	8.2	0.3	-.65	1.34
Total hardness	20	233	90	734	173	2.44	5.44
Chloride	20	138	4.0	1240	337	2.94	7.63
Sulfate	14	22	10	34	7.3	-.11	-.91
Iron	0						
Fluoride	3	0.2	0.2	0.2			
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	12	1.6	0.2	8.9	3.0	2.11	3.06
Boron	2	60	40	80			

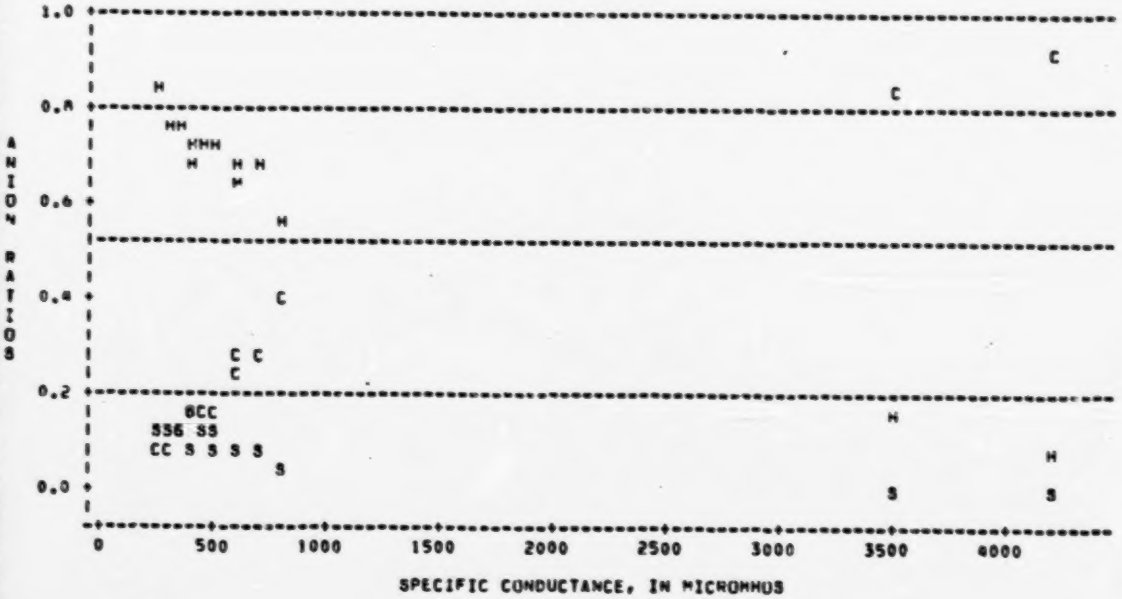
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	224	292	417	579	791
Dissolved solids	151	189	261	349	429
pH	7.3	7.5	7.6	7.8	7.9
Total hardness	102	138	192	240	273
Chloride	5.0	10	25	51	109
Sulfate	11	14	23	26	30
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.1	0.2	0.4	0.4	5.9
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=SALT CREEK NR ALLUWE, OK

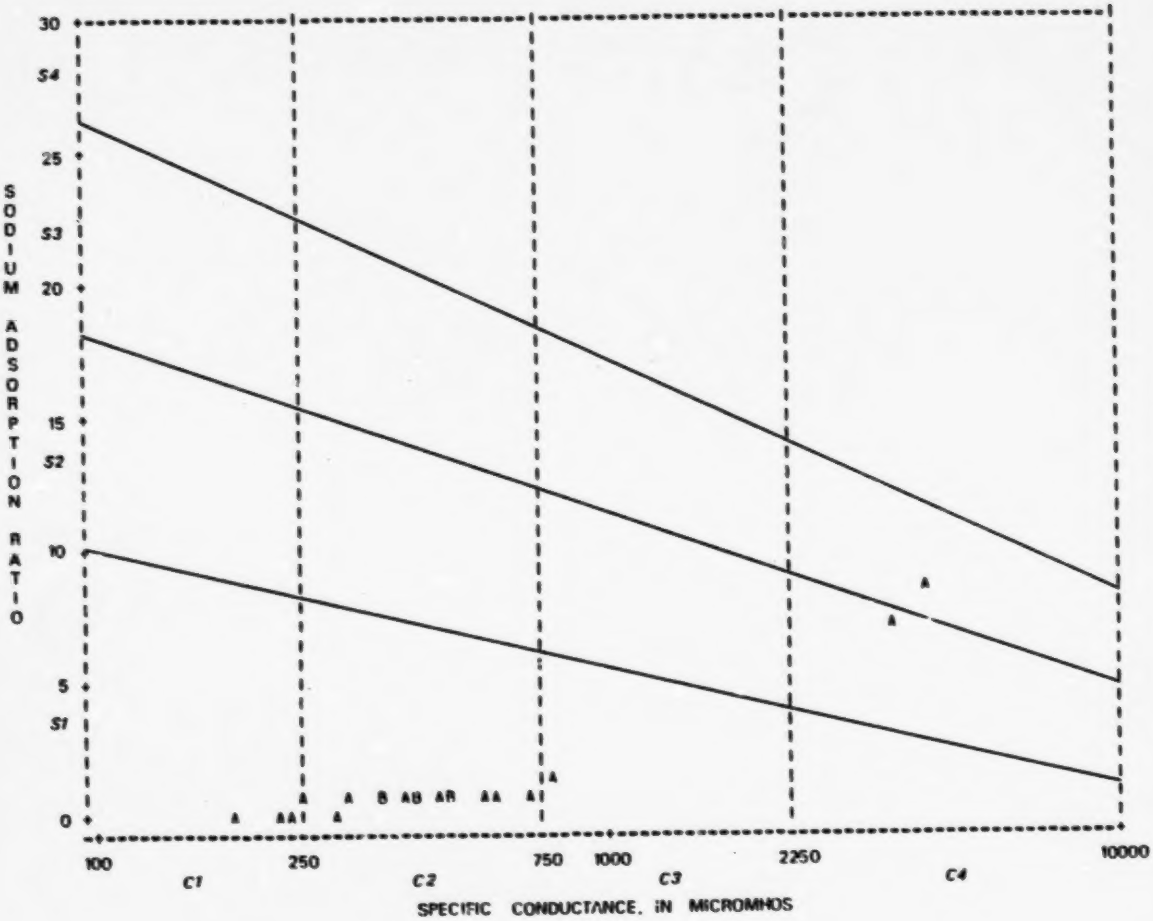


ANION RATIO PLOT
M IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=SALT CREEK NR ALLUWE, OK



BEST DOCUMENT AVAILABLE

IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=SALT CREEK NR ALLUWE, OK



VERDIGRIS RIVER BASIN

07174600 - Sand Creek at Okesa, Okla.

LOCATION.--Lat 36°43'10", long 69°07'56", in NW¼NW¼ sec.21, T.26 N., R.11 E., Osage County, at county road bridge, 0.5 mi mortheast of Okesa, 9 mi southwest of Bartlesville, and at mile 17.2.

DRAINAGE AREA.--139 mi^2.

PERIOD OF RECORD.--1952 to 1955, 1960 to 1962.

WATER TYPE.--The water type varied with the specific conductance. The water was calcium carbonate/bicarbonate type for specific conductance less than or equal to 600 umhos, which occurred in 92 percent of the samples. Chloride predominated for specific conductance greater than 600 umhos. Cation data indicate the sodium ion increases as the specific conductance increases and may be predominant for specific conductance greater than 1,000 umhos.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 130 mg/L and the water was hard. Hardness concentrations were greater than 120 mg/L for 53 percent of the hardness values. None of the constituents exceeded the recommended maximum concentrations. No toxic element data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to high with only 6 percent of the samples in the high salinity hazard class. The sodium hazard was low class for all SAR values. No boron data were available.

07174600 - Sand Creek at Okesa, Okla.--Continued

UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	51	356	146	1050	176	1.90	4.61
Dissolved solids	15	298	93	647	143	1.29	1.53
pH	51	7.9	7.0	8.5	0.4	-.52	-.37
Total hardness	51	130	56	258	47	.93	.76
Chloride	51	40	10	242	43	2.96	10.12
Sulfate	16	25	11	39	9.3	.14	-1.19
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	47	0.8	0.3	3.3	0.6	2.43	6.84
Boron	0						

FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	201	232	317	387	578
Dissolved solids	148	217	236	333	471
pH	7.2	7.6	7.9	8.1	8.4
Total hardness	74	92	124	151	191
Chloride	13	16	22	39	76
Sulfate	12	15	23	30	36
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.4	0.5	0.6	0.9	1.5
Boron					

```
CATION RATIO PLOT
N IS SODIUM ION RATIO,  C IS CALCIUM ION RATIO,  M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=SAND CREEK AT OKESA, OK
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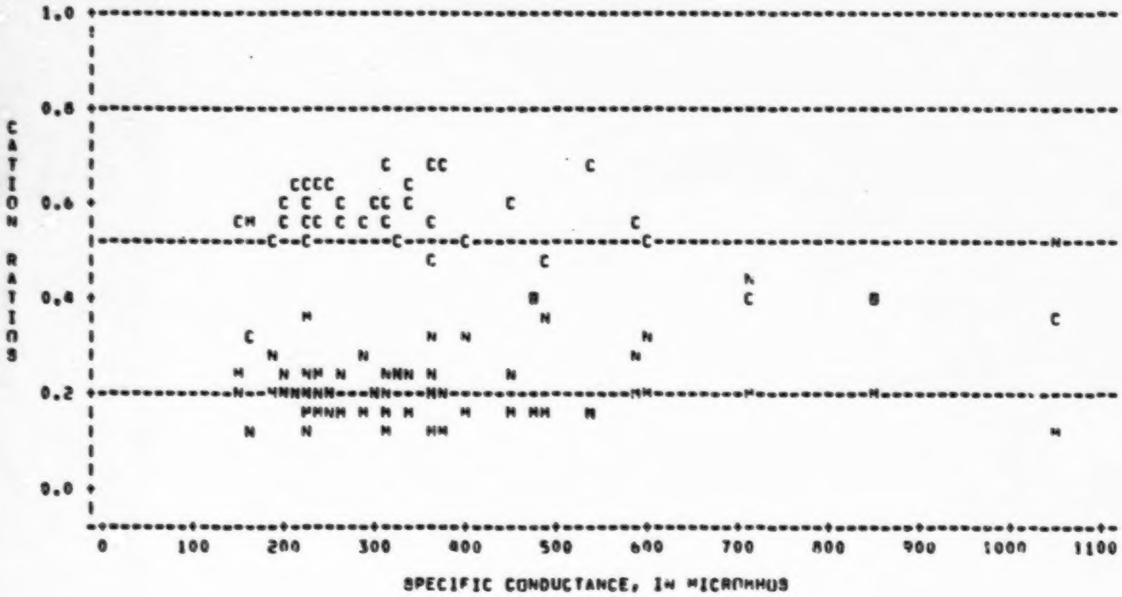

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ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO,  C IS CHLORIDE ION RATIO,  S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=SAND CREEK AT OKESA, OK
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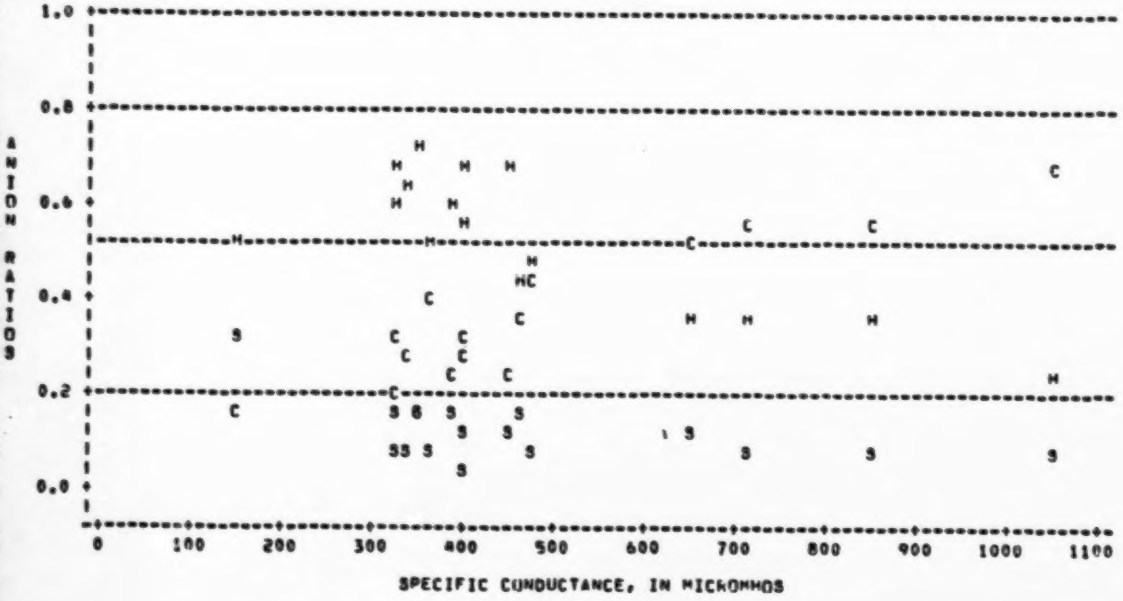

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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=SAND CREEK AT OKEMA, OK
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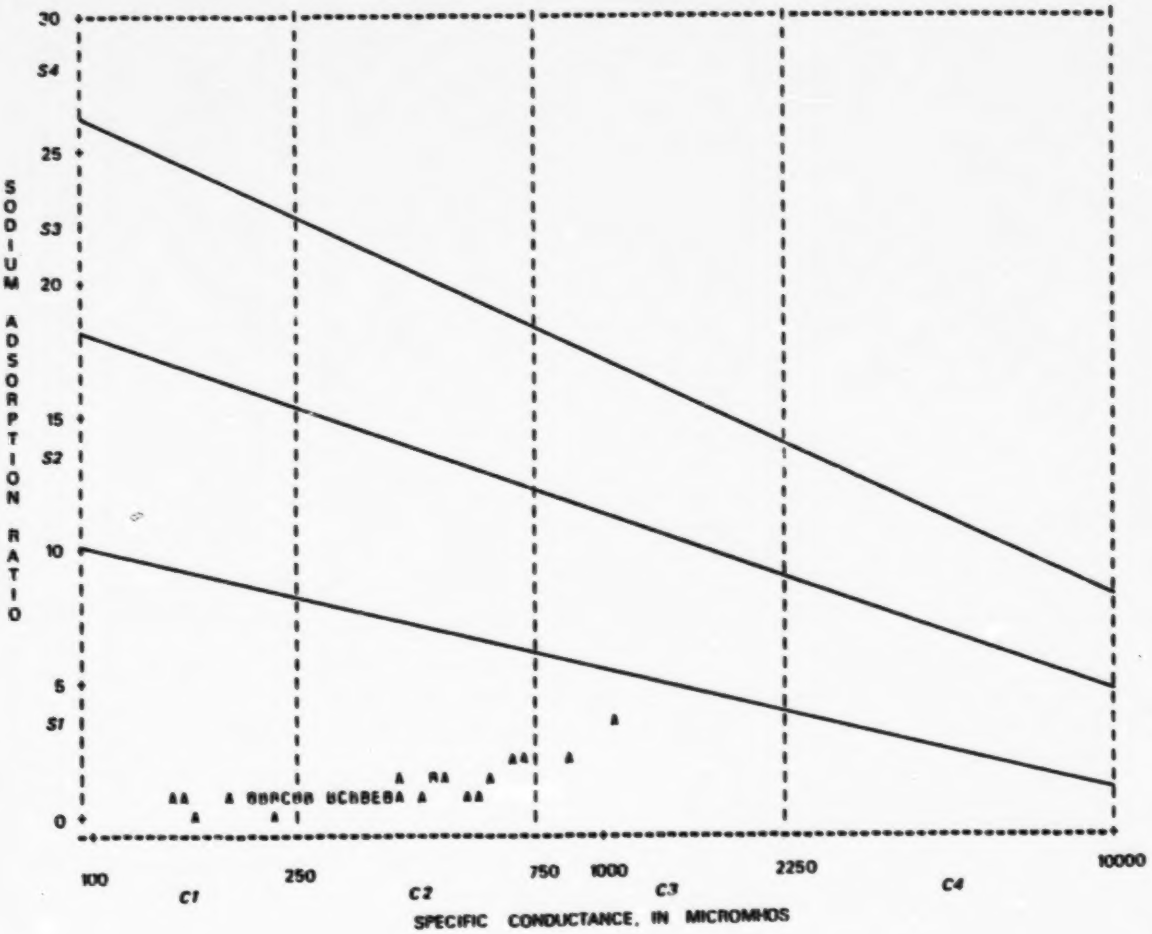


BEST DOCUMENT AVAILABLE

07170950 - Verdigris River near South Coffeyville, Okla.

LOCATION.--Lat 36°59'18", long 95°35'45", in SW¼ sec.20, T.29 N., R.16 E., Nowata County, at bridge on county road, 1.0 mi southeast of South Coffeyville.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1952 to 1953.

WATER TYPE.--The water varied from bicarbonate type to chloride type depending on the specific conductance. The water was bicarbonate type for specific conductance less than 800 umhos, which occurred in 67 percent of the samples, and was chloride type for specific conductance greater than 1,000 umhos. Cation data were inadequate to assess their relationship with specific conductance. Downstream data indicate the water at this location probably changes from calcium type to sodium type as the specific conductance increases.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 240 mg/L and the water was very hard. Hardness concentrations were greater than 180 mg/L, very hard class, for all hardness values. None of the constituents exceeded recommended maximum concentration limits. No toxic element data were available. Based on the data, this water should be suitable suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from medium to high with 58 percent of the samples in the medium salinity hazard class. The sodium hazard was low class for all SAR values. No boron data were available.

07170950 - Verdigris River near South Coffeyville, Okla.--Continued

UNIVARIATE STATISTICS

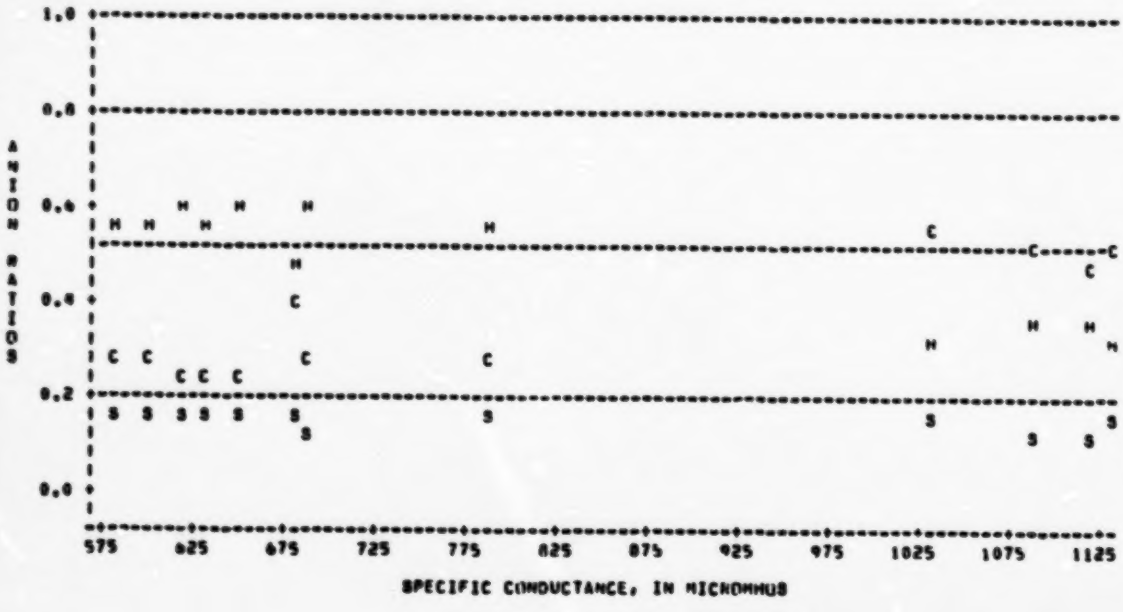
CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	12	801	584	1130	223	0.68	-1.56
Dissolved solids	12	456	344	618	103	.58	-1.44
pH	12	7.6	6.9	7.9	0.4	-.91	-.33
Total hardness	12	240	208	296	28	.68	-.42
Chloride	12	106	56	192	60	.72	-1.64
Sulfate	12	56	43	70	10	.13	-1.91
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	3	3.8	3.5	4.1			
Boron	0						

FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	587	620	681	1030	1114
Dissolved solids	346	361	409	553	600
pH	6.9	7.3	7.6	7.8	7.9
Total hardness	208	212	232	258	270
Chloride	34	58	68	178	187
Sulfate	43	45	53	64	68
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR					
Boron					

No cation distribution data are available.

ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR S COFFEYVILLE, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR S COFFEYVILLE, OK
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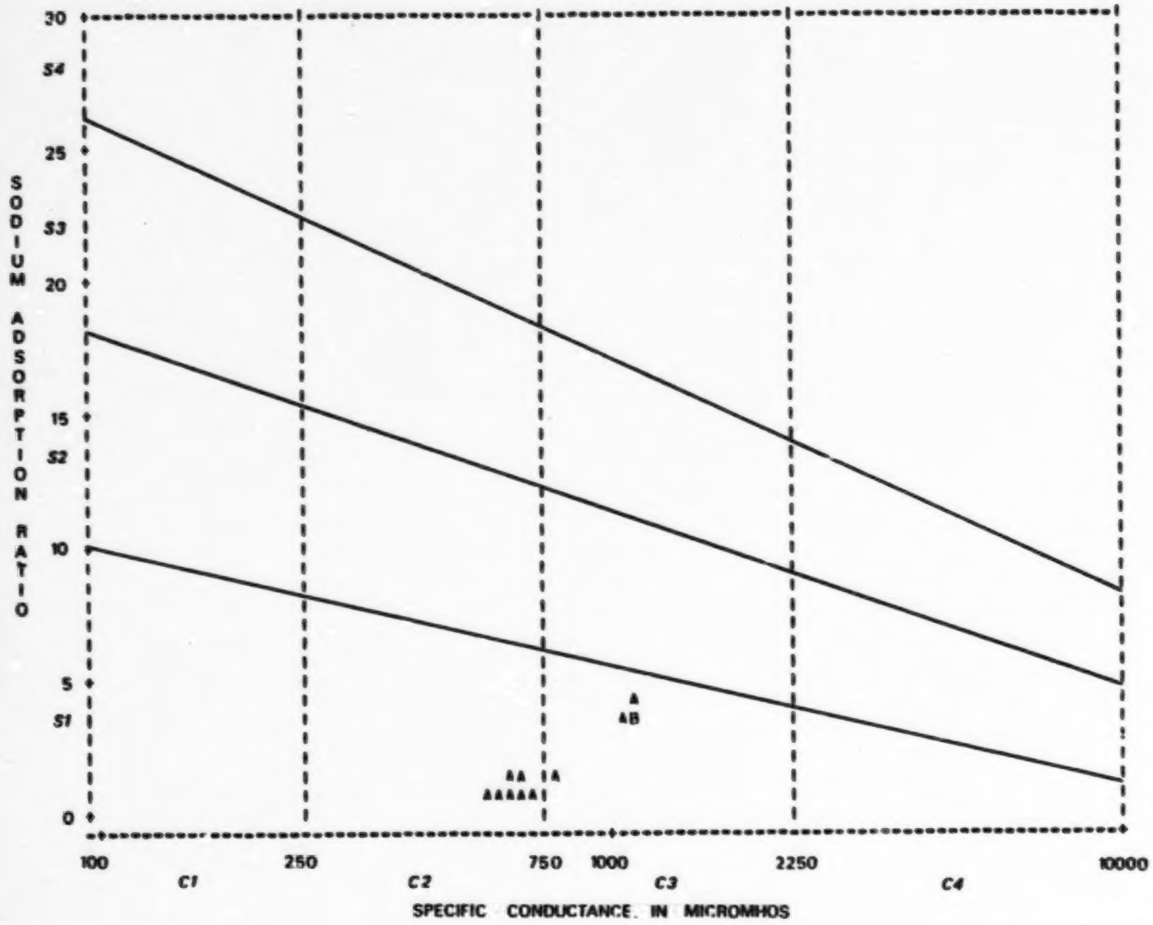


BEST DOCUMENT AVAILABLE

07171000 - Verdigris River near Lenapah, Okla.

LOCATION.--Lat 36°51'05", long 95°35'06", at center of sec.3, T.27 N., R.16 E., Nowata County, at county road bridge, 2.8 mi east of Lenapah, 4.5 mi upstream from Cedar Creek, and at mile 144.6.

DRAINAGE AREA.--3,639 mi^2.

PERIOD OF RECORD.--1952 to 1964, 1976 to 1978.

WATER TYPE.--The water varied from calcium carbonate/bicarbonate type to sodium chloride type depending on the specific conductance. The shift in water type occurred at about specific conductance of 800 umhos. For specific conductance of 800 umhos or less, which occurred in 79 percent of the samples, the water was calcium carbonate/bicarbonate type, and for specific conductance greater than 800 umhos, the water was sodium chloride type.

TREND.--The current period of record was insufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 196 mg/L, and the water was very hard. For 52 percent of the hardness values the concentration was greater than 180 mg/L, very hard class. The recommended maximum chloride concentration of 250 mg/L was exceeded by 3 percent of the chloride values and the recommended maximum sulfate concentration of of 250 mg/L was exceeded by less than 1 percent of the sulfate values. One value in 630 exceeded the recommended maximum pH of 9.0. Two samples were analyzed for cadmium, and concentrations were less than the maximum contaminant level of 10 ug/L. No other toxic element data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to high with 27 percent of the samples in the high salinity hazard class. The sodium hazard ranged from low to medium with about 99 percent of the SAR values in the low sodium hazard class. The data indicate that phytotoxic effects from boron should not occur.

07171000 - Verdigris River near Lenapah, Okla.--Continued

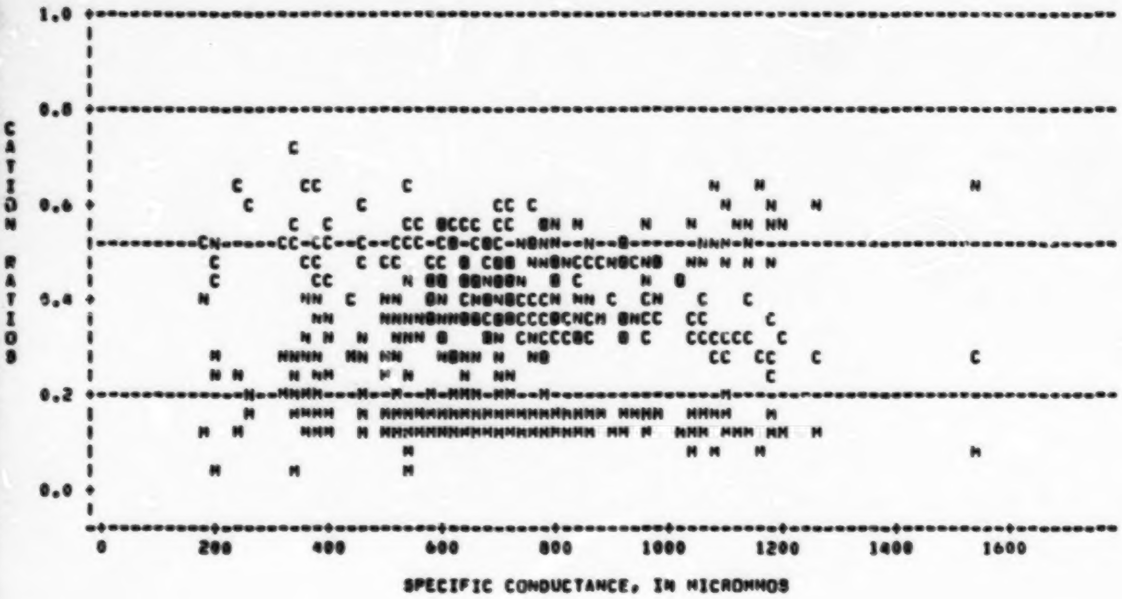
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	655	645	124	1560	241	0.60	0.34
Dissolved solids	616	388	114	937	136	.52	.14
pH	630	8.0	6.4	9.5	0.4	-.54	1.16
Total hardness	620	196	48	370	56	.11	-.10
Chloride	651	96	7.0	375	60	1.28	1.88
Sulfate	597	40	5.6	375	21	7.44	114.08
Iron	0						
Fluoride	112	0.3	0.0	0.7	0.2	.19	-.16
Arsenic	0						
Cadmium	2	0	0	0			
Chromium	0						
Lead	0						
Mercury	0						
SAR	382	2.0	0.4	5.6	1.0	.90	.41
Boron	110	186	0	600	144	.82	.23

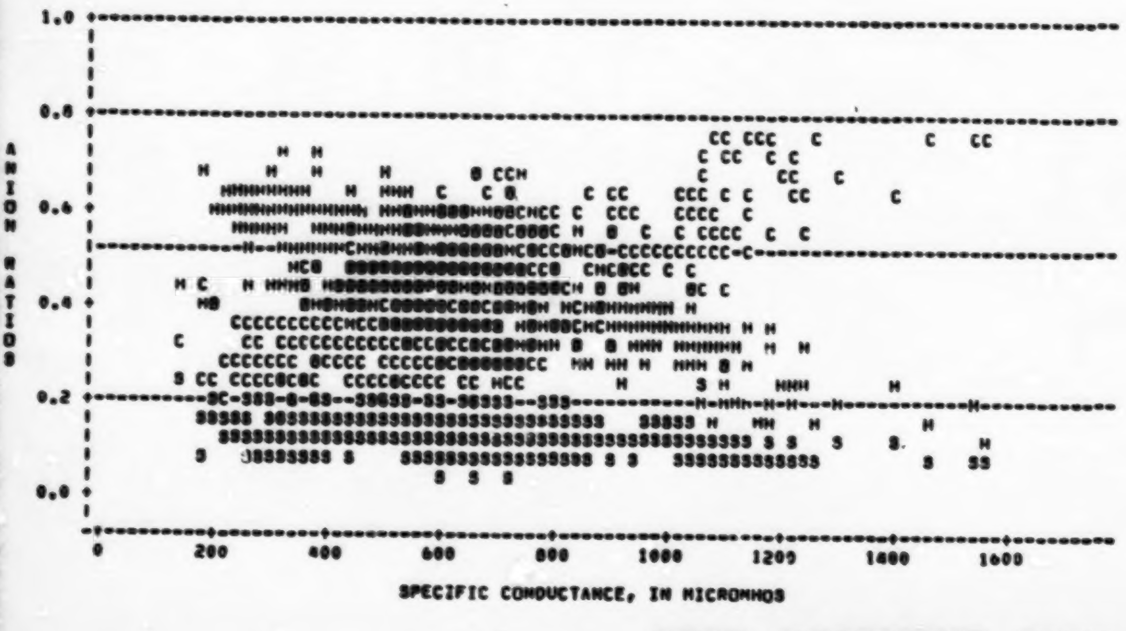
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	348	484	622	763	1014
Dissolved solids	209	294	375	459	588
pH	7.4	7.7	8.0	8.2	8.4
Total hardness	120	160	194	234	268
Chloride	34	54	80	124	174
Sulfate	20	29	38	49	58
Iron					
Fluoride	0.0	0.0	0.3	0.3	0.4
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.9	1.2	1.8	2.6	3.4
Boron	10	62	160	260	380

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR LENAPAH, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR LENAPAH, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR LENAPAH, OK
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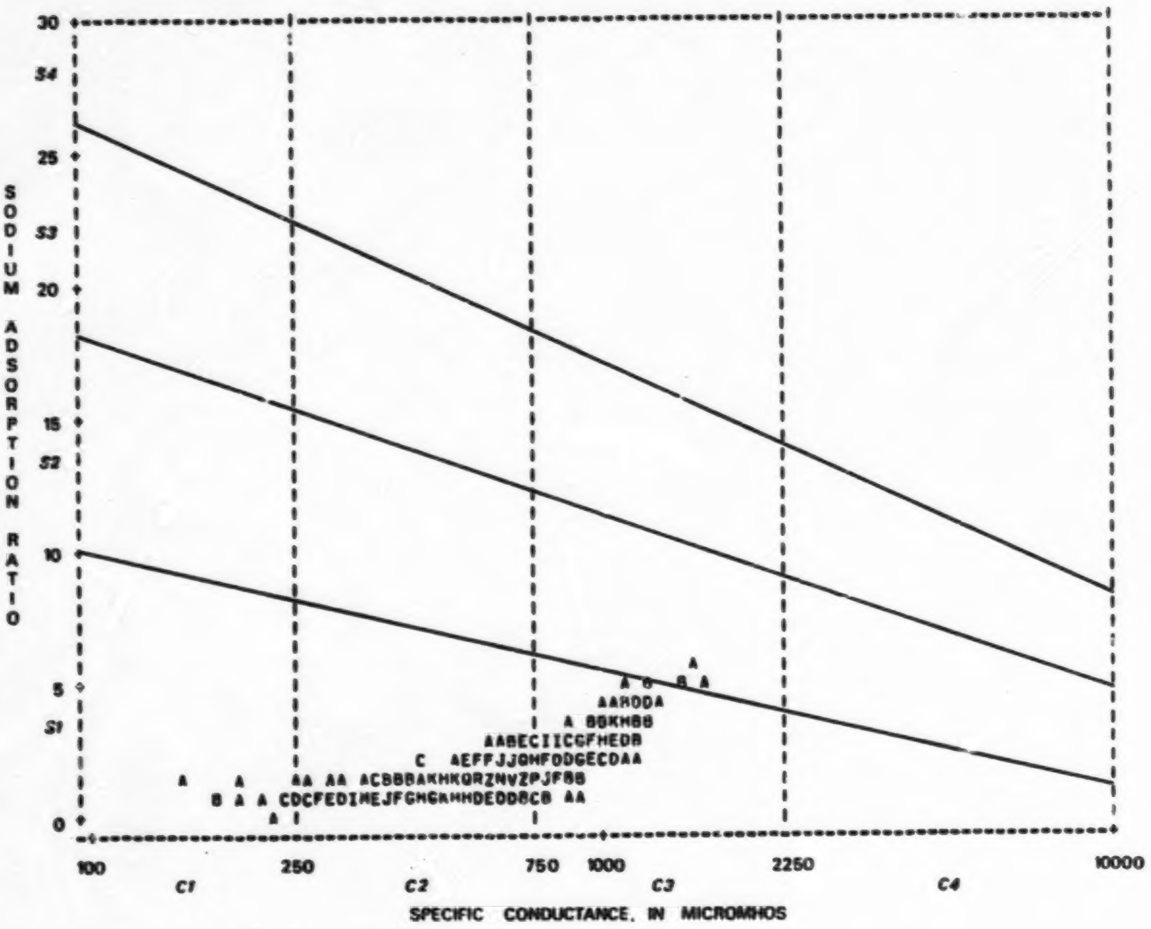


VERDIGRIS RIVER BASIN

07171400 - Verdigris River near Oologah, Okla.

LOCATION.--Lat 36°25'17", long 95°41'01", in NW¼ sec.2, T.22 N., R.15 E., Rogers County, 0.3 mi downstream from Oologah Dam, 1.2 mi upstream from Fourmile Creek, 2 mi southeast of Oologah, and at mile 90.0

DRAINAGE AREA.--4,339 mi^2.

PERIOD OF RECORD.--1962 to 1963, 1965 to 1978.

WATER TYPE.--The water was calcium bicarbonate type for specific conductance less than 600 umhos, which occurred in 75 percent of the samples. For the specific conductance range from 600 to 1,200 umhos, the water was mixed type. In this range, the bicarbonate and calcium ions decreased and the sulfate ion increased. Sulfate predominated for specific conductance greater than 1,600 umhos, which occurred in only 2 percent of the samples. There were insufficient data to determine whether any cation predominated for specific conductance greater than 1,200 umhos.

TREND.--Plots of dissolved solids, hardness, sulfate, and chloride concentrations versus time indicated the possibility of negative trends for hardness, chloride, and dissolved solids. The Spearman's rhos for the four constituents showed negative trends at the 95-percent probability level.

PUBLIC WATER SUPPLY.--The average hardness was 178 mg/L and the water was hard, For 82 percent of the hardness values the concentration was greater than 120 mg/L, the lower limit for hard water, and was greater than 180 mg/L, very hard, for 34 percent of the values. The recommended maximum limit for pH of 9.0 was exceeded by 1 value in 213. The recommended maximum chloride concentration of 250 mg/L was exceeded less than 1 percent of the chloride values, and the recommended maximum sulfate concentration of 250 mg/L was exceeded by 2 percent of the sulfate values. No toxic element data were available. Based on the data, this water is probably suitable for use as a public supply; however, chloride and sulfate concentrations should be monitored.

IRRIGATION.--The salinity hazard ranged from low to high with 90 percent of the samples having a low or medium salinity hazard, less than 750 umhos specific conductance. The sodium hazard was low class for all SAR values. No boron data were available.

07171400 - Verdigris River near Oologah, Okla.--Continued

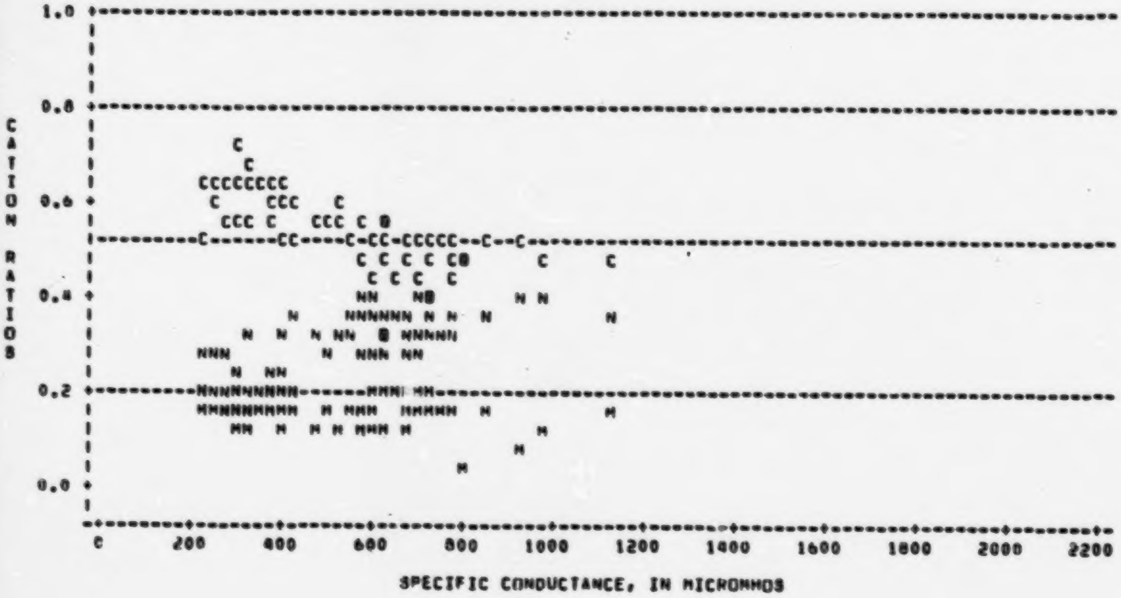
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	249	509	185	1970	266	2.77	10.30
Dissolved solids	182	334	109	1510	195	3.36	15.53
pH	213	7.7	6.4	9.7	0.4	.23	3.08
Total hardness	187	178	74	810	88	4.46	27.37
Chloride	220	60	0.0	280	47	1.74	3.94
Sulfate	187	52	8.4	730	82	6.89	50.64
Iron	0						
Fluoride	47	0.4	0.1	0.8	0.2	.94	.60
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	156	1.1	0.4	2.8	0.5	1.10	.93
Boron	0						

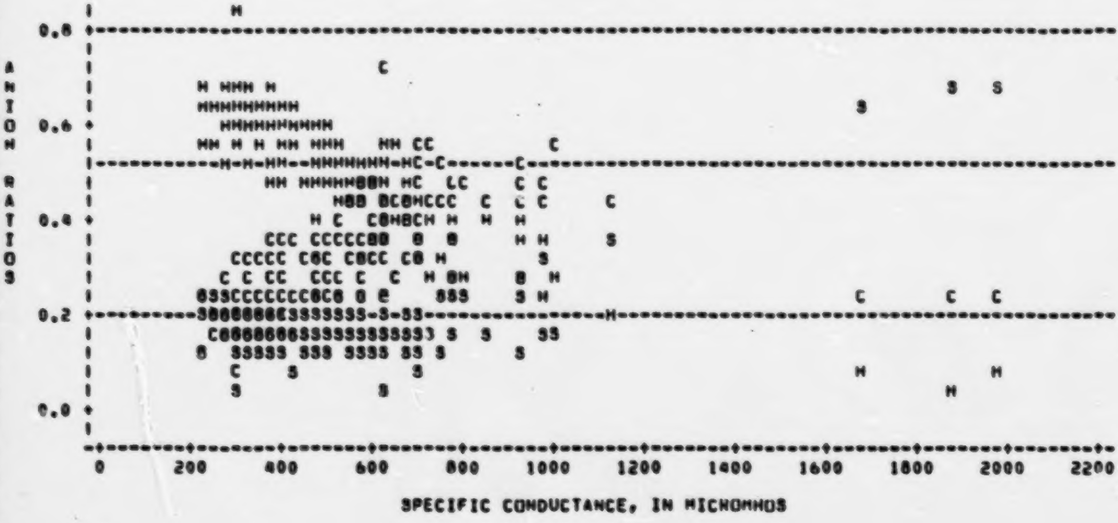
FREQUENCY DISTRIBUTION

	PERCENTILE CONCENTRATION				
CONSTITUENT	10th	25th	50th	75th	90th
Specific conductance	290	348	445	603	738
Dissolved solids	182	218	295	394	468
pH	7.2	7.5	7.7	7.9	8.2
Total hardness	110	130	168	200	241
Chloride	17	25	45	81	124
Sulfate	22	29	36	48	64
Iron					
Fluoride	0.2	0.2	0.4	0.4	0.5
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.6	0.6	0.9	1.2	1.7
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR OOLOGAH, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR OOLOGAH, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR OOLOGAH, OK
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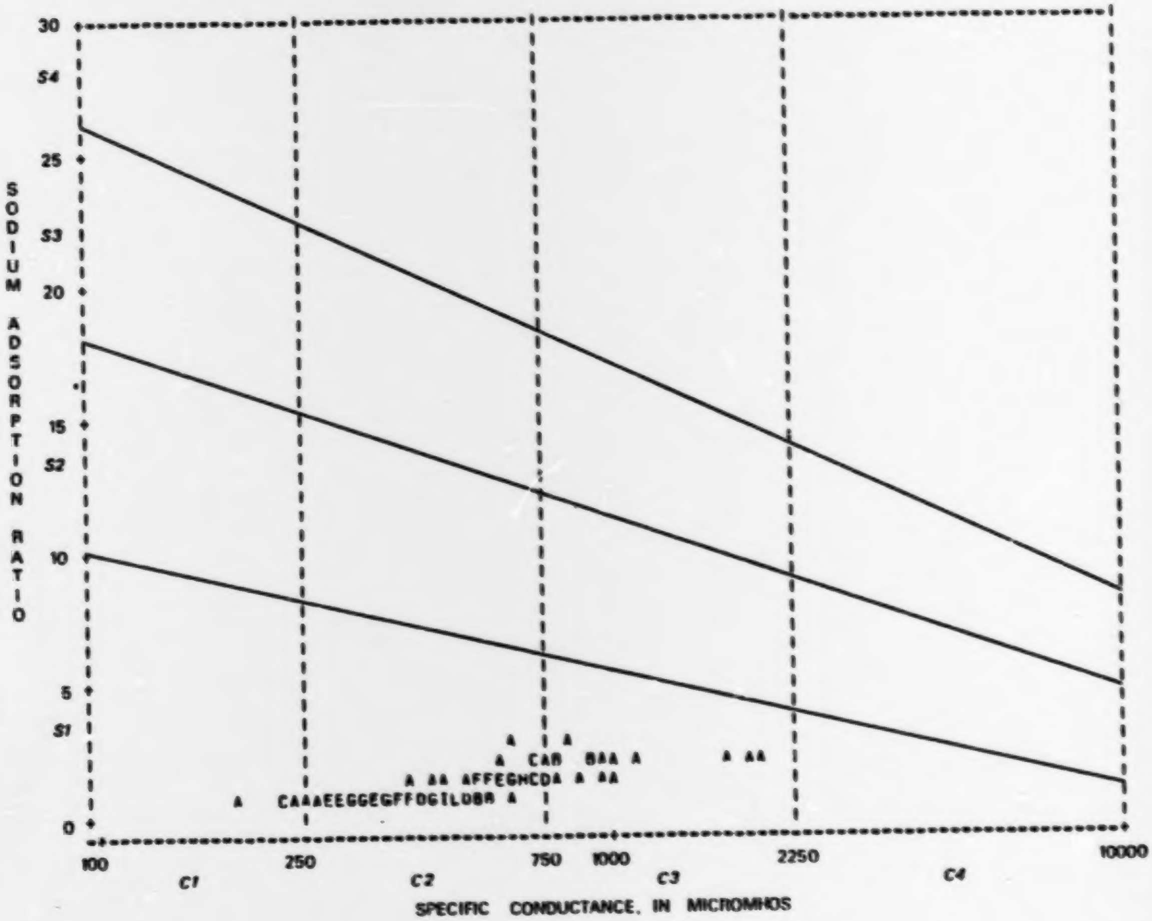


BEST DOCUMENT AVAILABLE

VERDIGRIS RIVER BASIN

07171405 - Verdigris River above Caney River, near Claremore, Okla.

LOCATION.--Lat 36°23'12", long 95°40'36", in SE¼NE¼ sec.14, T.22 N., R.15 E., Rogers County, at bridge on State Highway 88, 5 mi northwest of Claremore.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1952 to 1953, 1959.

WATER TYPE.--The water was calcium carbonate/bicarbonate type for specific conductance less than 500 umhos, which occurred in 22 percent of the samples. The carbonate/bicarbonate ion ratio was greater than 50 percent for specific conductance less than 740 umhos, which occurred in 70 percent of the samples. For specific conductance greater than 740 umhos there was no predominant anion and for specific conductance greater than 500 umhos there was no predominant cation.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 209 mg/L and the water was very hard. Hardness concentrations were greater than 180 mg/L, very hard class, for 67 percent of the hardness values and greater than 120 mg/L for 89 percent of the values. None of the measured constituents exceeded recommended maximum concentrations. No toxic element data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to high, with 74 percent of the samples having a low or medium salinity hazard. The sodium hazard was low class for all SAR values. The data indicate that phytotoxic effects from boron should not occur.

07171405 - Verdigris River above Caney River, near Claremore, Okla.--Continued

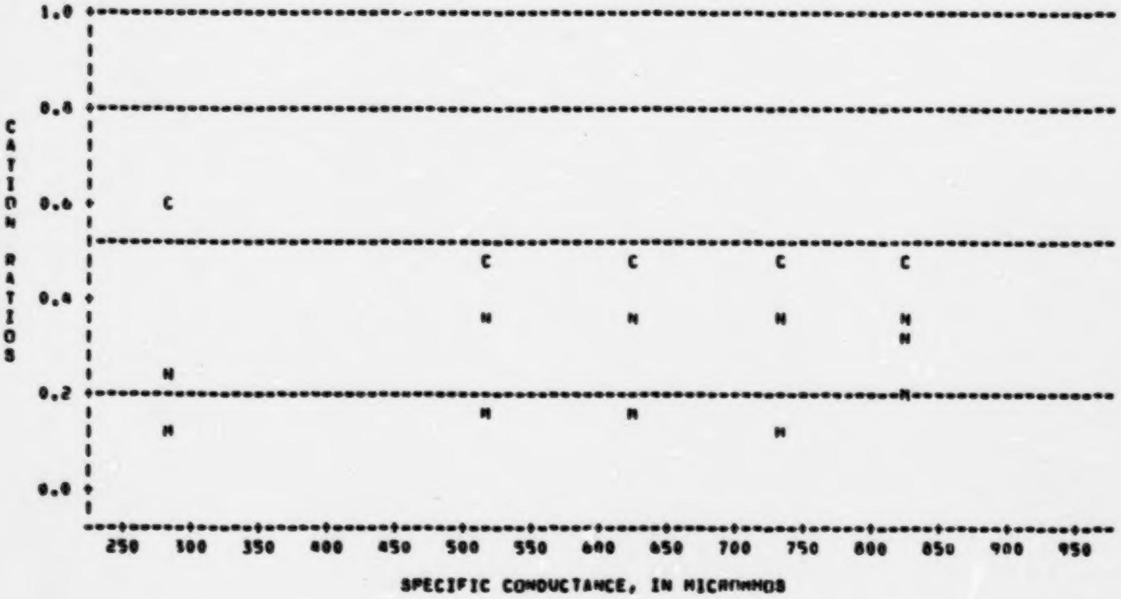
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	27	634	286	971	177	-0.31	-0.59
Dissolved solids	27	381	185	544	100	-.33	-.08
pH	27	7.8	7.4	8.4	0.2	.19	.58
Total hardness	27	209	112	288	53	-.26	-.86
Chloride	27	88	24	172	37	.28	-.45
Sulfate	18	45	18	58	11	-.81	.93
Iron	0						
Fluoride	5	0.3	0.2	0.4			
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	19	1.5	0.7	2.7	0.5	.63	.08
Boron	3	93	80	100			

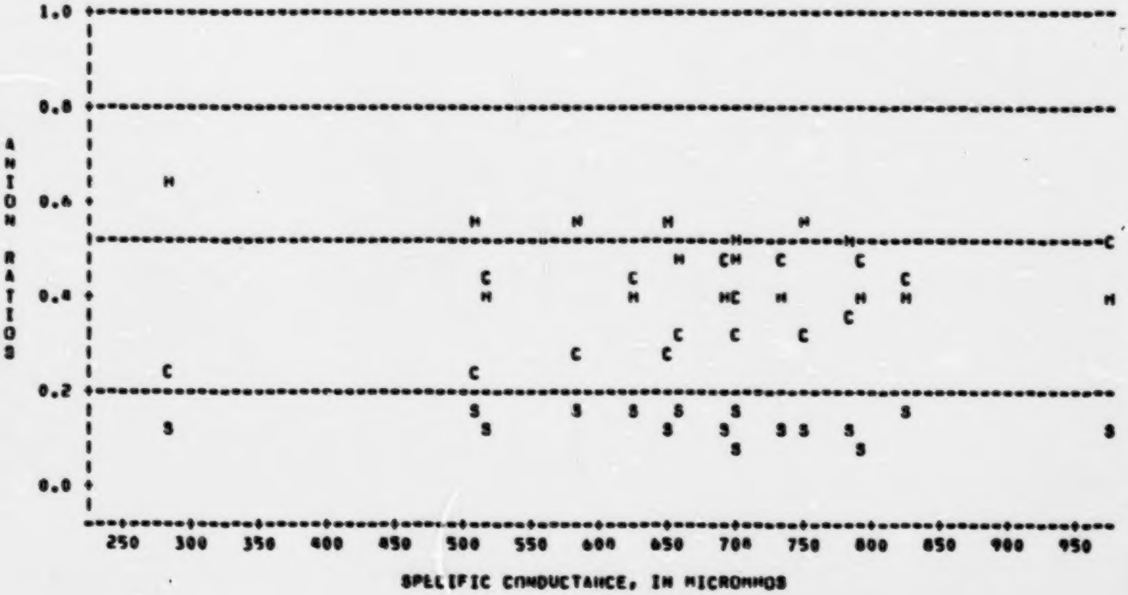
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	330	500	655	758	828
Dissolved solids	211	302	388	456	492
pH	7.6	7.7	7.8	8.0	8.1
Total hardness	119	163	200	246	280
Chloride	37	61	80	116	130
Sulfate	29	38	44	51	57
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.8	1.0	1.4	1.7	2.1
Boron					

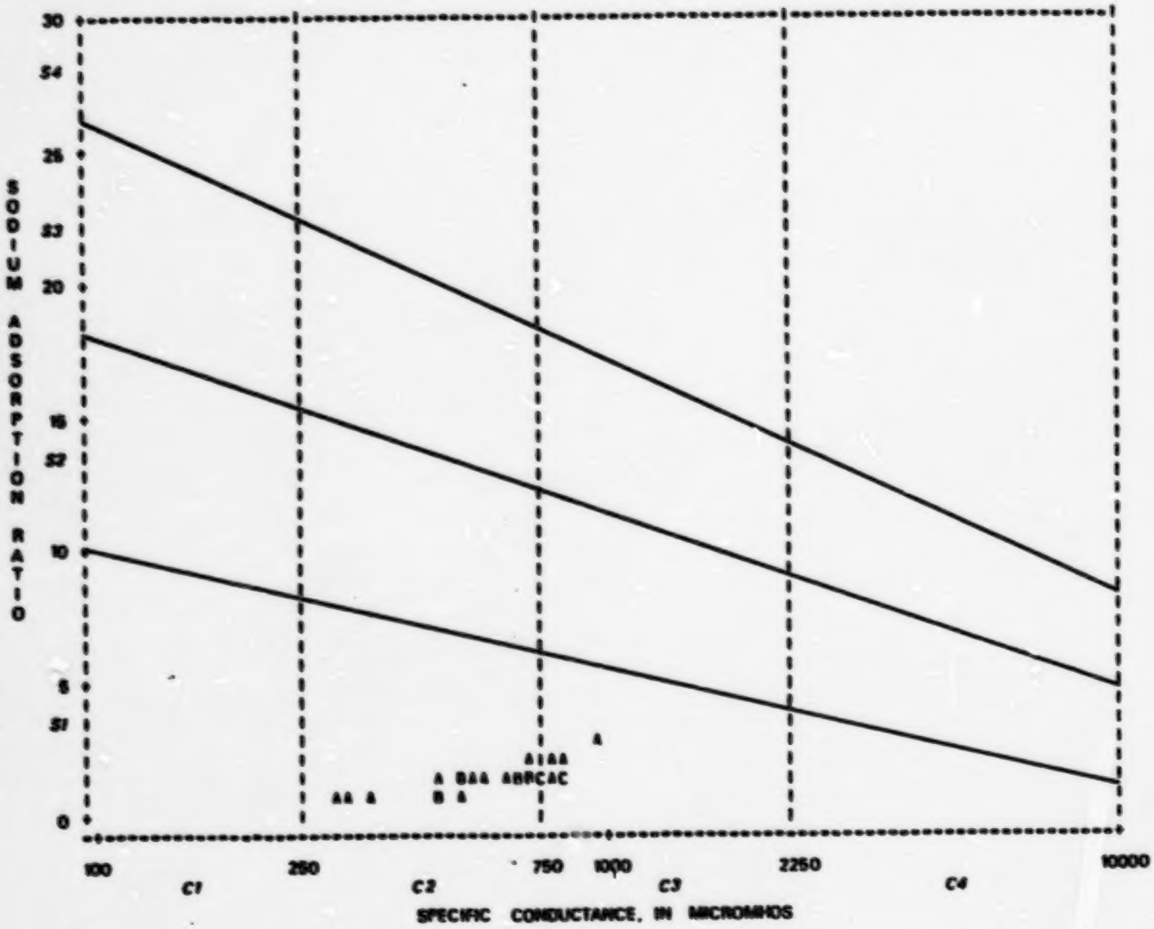
CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER AB CANEY RIVER NR CLAREMORE, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER AB CANEY RIVER NR CLAREMORE, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER AB CANEY RIVER NR CLAREMORE, OK



BEST DOCUMENT AVAILABLE

VERDIGRIS RIVER BASIN

07176000 - Verdigris River near Claremore, Okla.

LOCATION.--Lat 36°18'26", long 95°41'52", in SE¼SW¼ sec.10, T.21 N., R.15 E., Rogers County, at bridge on State Highway 20, 2.3 mi downstream from Caney River, 4.5 mi west of Claremore, 12.4 mi upstream from Bird Creek, and at mile 76.0.

DRAINAGE AREA.--6,534 mi^2.

PERIOD OF RECORD.--1948 to 1954, 1959, 1978.

WATER TYPE.--The water was calcium bicarbonate type for specific conductance less than or equal to 700 umhos, which occurred in 62 percent of the samples. For specific conductance greater than 700 umhos, the water was sodium chloride type.

TREND.--The current period of record was insufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 196 mg/L and the water was very hard. Hardness concentrations were greater than 180 mg/L, very hard class, for 58 percent of the hardness values. The recommended maximum chloride concentration of 250 mg/L was exceeded by less than 2 percent of the chloride values. No toxic element data available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to high, with 32 percent of the samples having a high salinity hazard. The sodium hazard was low class for all SAR values. The data indicate that phytotoxic effects from boron should not occur.

07176000 - Verdigris River near Claremore, Okla.--Continued

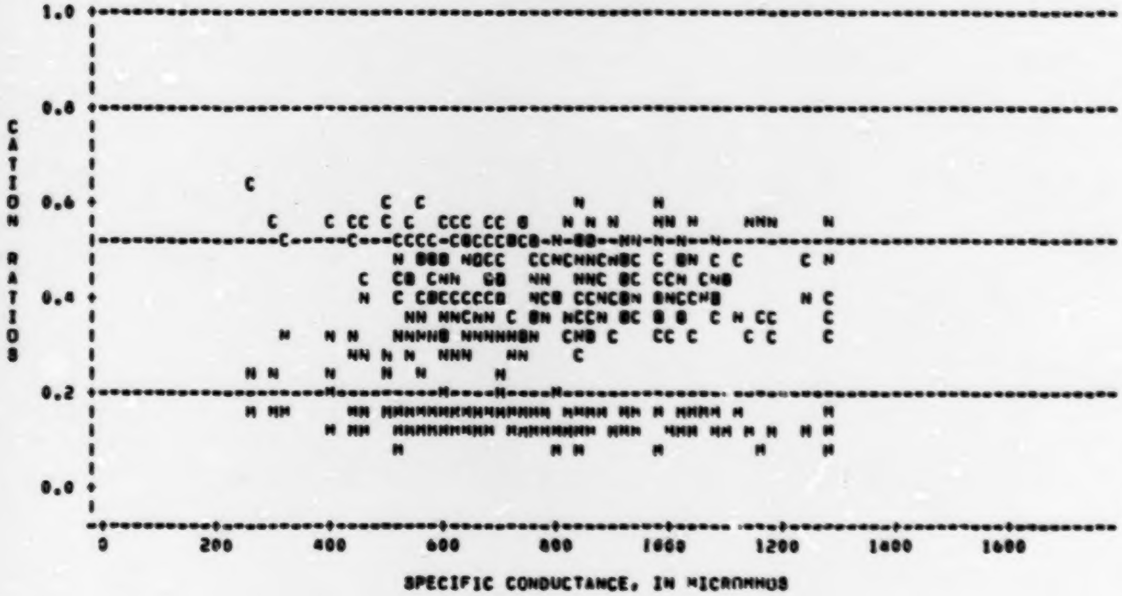
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	398	646	154	2000	268	0.79	1.43
Dissolved solids	380	384	126	747	141	.37	-.46
pH	249	8.0	7.1	9.0	0.3	-.11	1.25
Total hardness	385	196	50	406	67	.38	-.11
Chloride	394	100	1.0	292	60	.68	-.28
Sulfate	393	33	8.2	87	14	.72	.73
Iron	0						
Fluoride	97	0.2	0.0	0.6	0.1	.49	-.04
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	167	2.1	0.5	4.3	0.8	.43	-.37
Boron	42	238	0	650	140	.91	1.02

FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	313	444	610	830	1006
Dissolved solids	205	281	374	478	580
pH	7.5	7.7	8.0	8.1	8.2
Total hardness	105	146	192	238	282
Chloride	30	52	86	144	189
Sulfate	16	23	31	42	51
Iron					
Fluoride	0.0	0.0	0.0	0.2	0.3
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	1.0	1.4	2.0	2.6	3.2
Boron	92	148	200	298	466

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR CLAREMORE, OK



ANION RATIO PLOT
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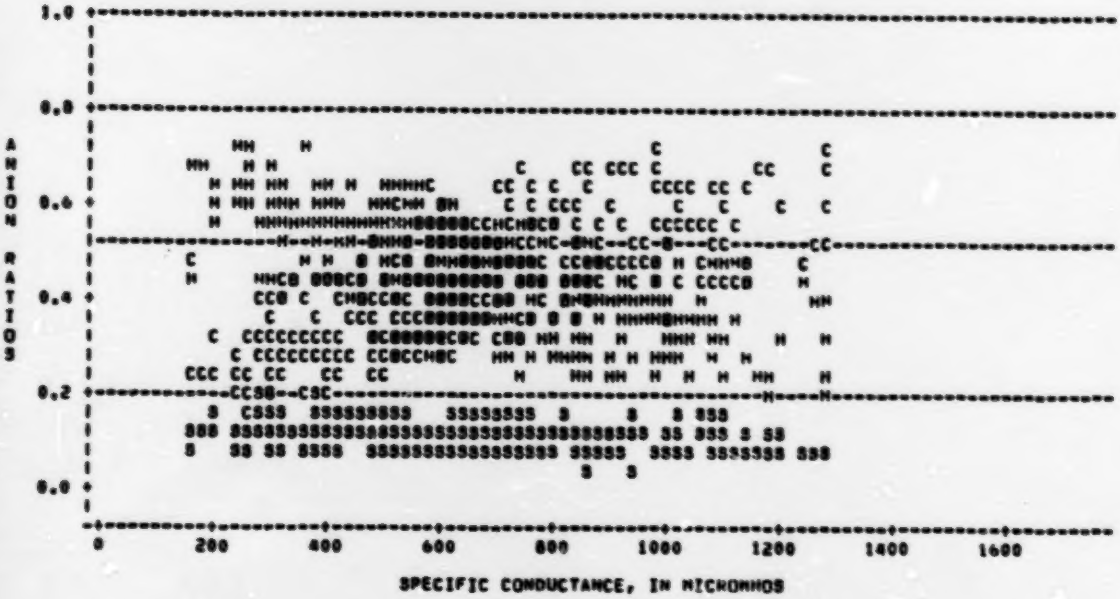
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR CLAREMORE, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS   B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR CLAREMORE, OK
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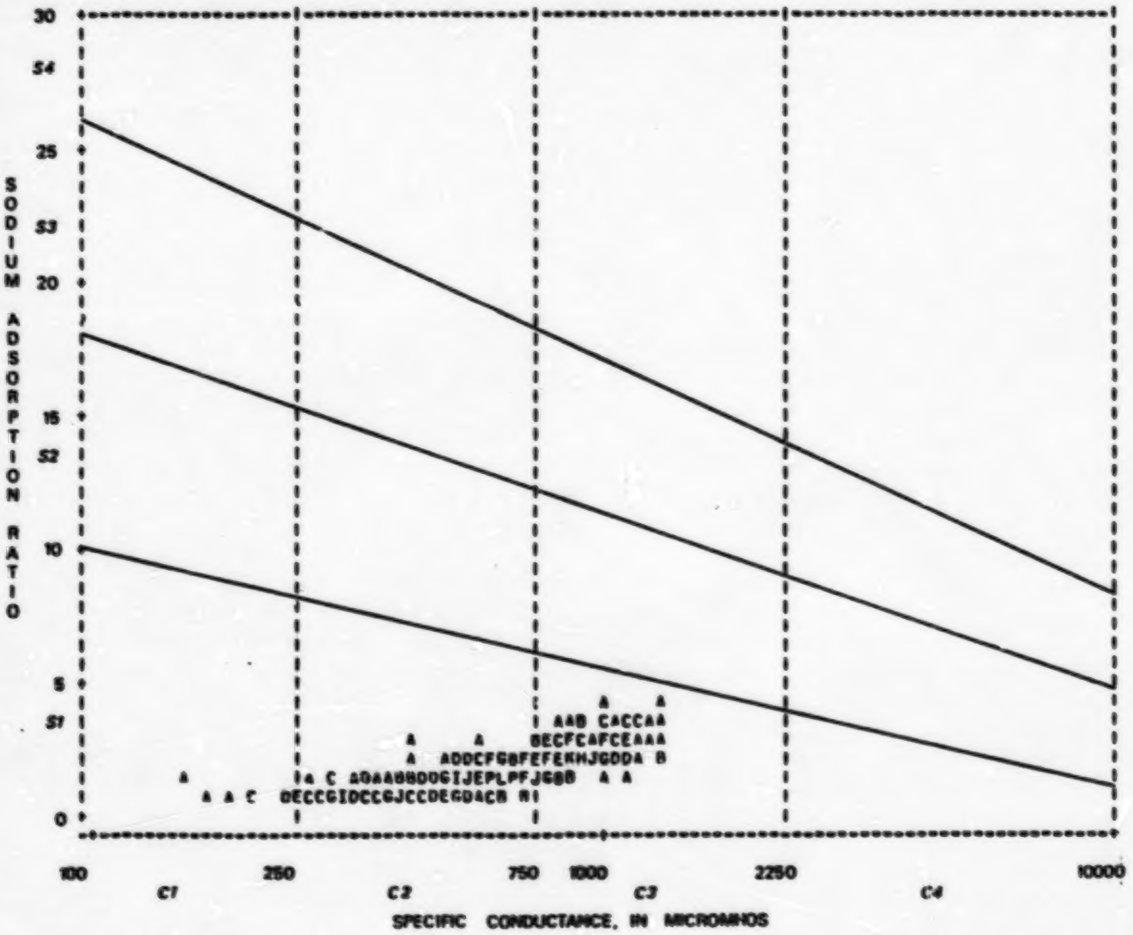


VERDIGRIS RIVER BASIN

07178600 - Verdigris River near Inola, Okla.

LOCATION.--Lat 36°09'43", long 95°37'07", in NW corner sec.4, T.19 N., R.16 E., Rogers County, at bridge on State Highway 33, 1.0 mi upstream from Salt Creek, 6.0 mi west of Inola, and at mile 48.8.

DRAINAGE AREA.--7,911 mi^2.

PERIOD OF RECORD.--1948 to 1972, 1977.

WATER TYPE.--The water was calcium carbonate/bicarbonate type for specific conductance less than or equal to 700 umhos, which occurred in 49 percent of the samples. For specific conductance greater than 700 umhos, the water was sodium chloride type.

TREND.--The current period of record was insufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 207 mg/L and the water was very hard. Hardness concentrations were greater than 180 mg/L, very hard class, for 59 percent of the hardness values. The recommended [redacted] pH value of 5.0 was exceeded by three values out of 1,246, [redacted] 0.5 percent, and the recommended maximum pH value of 9.0 was exceeded by 14 values, less than 0.5 percent. The recommended maximum chloride concentration of 250 mg/L was exceeded by 24 percent of the chloride values. Seven samples were analyzed for the toxic elements. The respective maximum contaminant levels for cadmium and lead were each exceeded once. Because of the frequency and magnitude by which the recommended maximum chloride concentration was exceeded and because the maximum contaminant levels for cadmium and lead were exceeded, this water is probably not suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to very high with 42 percent of the samples in the high salinity hazard class and 4 percent of the samples in the very high class. The sodium hazard also ranged from low to very high with less than about 2 percent of the SAR values in the high or very high sodium hazard classes. In one sample, the boron concentration was such that phytotoxic effects could occur in boron tolerant plants. Boron concentrations were above the "safe" range for sensitive plants for 2 percent of the boron values. If this water is used for irrigation, boron concentrations should be monitored.

07178600 - Verdigris River near Inola, Okla.--Continued

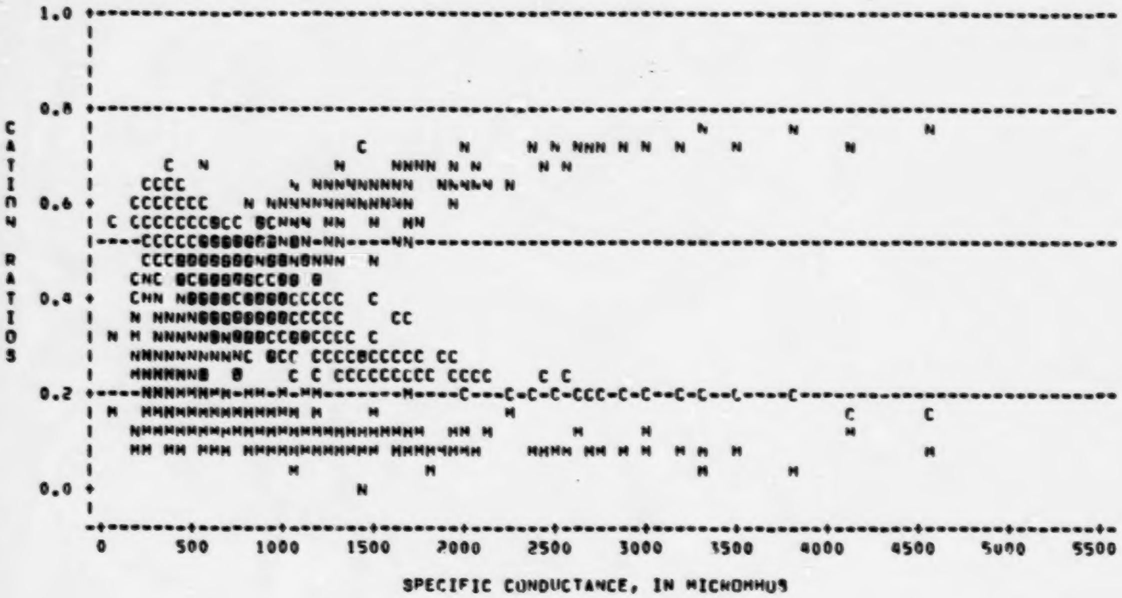
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	1519	901	56	5510	655	2.53	9.43
Dissolved solids	1492	530	87	3060	371	2.63	10.33
pH	1246	8.0	2.3	9.6	0.5	-3.22	35.51
Total hardness	1443	207	42	580	78	.87	1.66
Chloride	1495	188	6.5	2300	208	3.40	17.86
Sulfate	1495	34	8.2	116	13	.89	1.89
Iron	7	79	10	280			
Fluoride	200	0.3	0.0	0.9	0.2	.94	1.11
Arsenic	7	2	1	3			
Cadmium	7	6	1	14			
Chromium	7	1	0	10			
Lead	7	19	2	66			
Mercury	7	0.0	0.0	0.0			
SAR	1151	3.0	0.0	17	2.4	2.01	5.26
Boron	84	221	0	2000	251	4.70	30.87

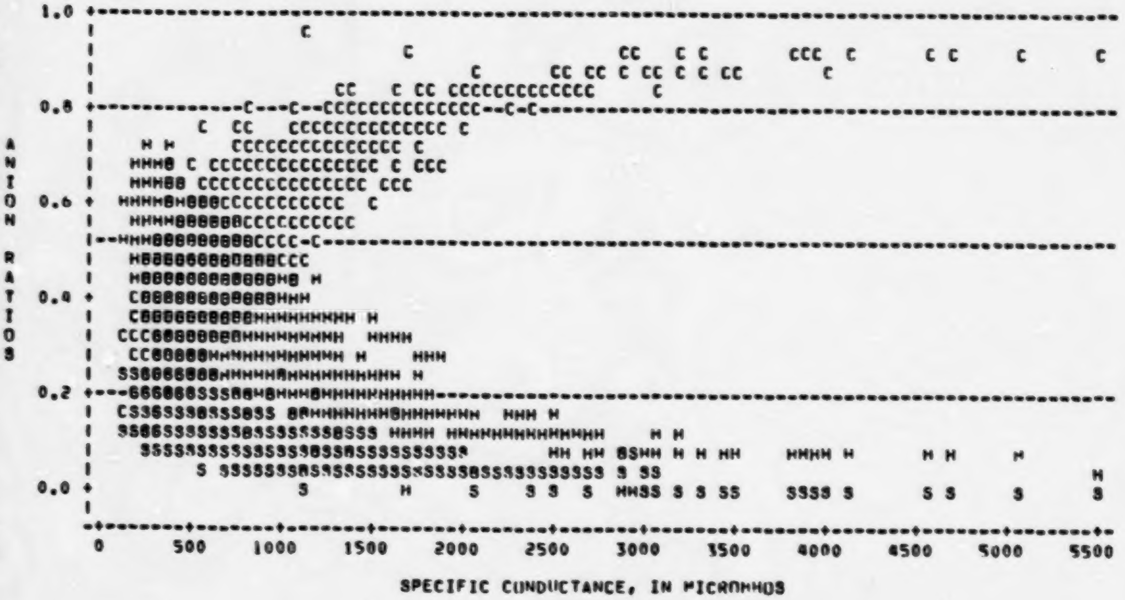
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	354	481	709	1122	1640
Dissolved solids	216	292	426	664	928
pH	7.4	7.6	8.0	8.2	8.4
Total hardness	114	150	200	251	303
Chloride	38	61	120	241	405
Sulfate	19	24	32	42	52
Iron					
Fluoride	0.0	0.1	0.2	0.3	0.5
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.9	1.3	2.2	4.0	6.0
Boron	32	80	165	290	400

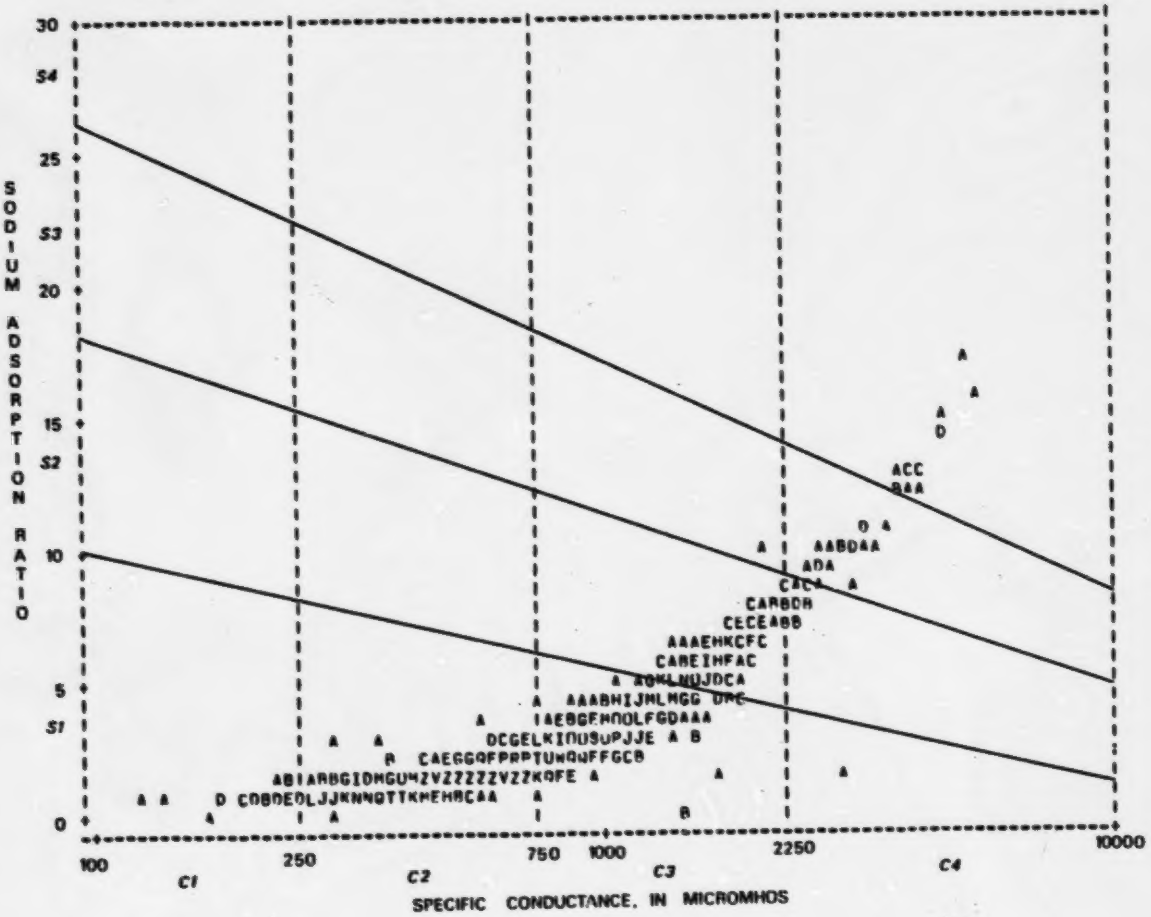
CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR INOLA, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR INOLA, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,   C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR INOLA, OK



VERDIGRIS RIVER BASIN

07178620 - Verdigris River at Newt Graham Lock and Dam, near Inola, Okla.

LOCATION.--Lat 36°03'24", long 95°32'06", in NW¼NE¼ sec.7, T.18 N., R.17 E., Wagoner County, at lock wall at dam, 6.8 mi southwest of Inola, and at navigation channel mile 25.7.

DRAINAGE AREA.--8,030 mi^2.

PERIOD OF RECORD.--1972 to 1977.

WATER TYPE.--The water was calcium carbonate/bicarbonate type for specific conductance less than or equal to 550 umhos, which occurred in 83 percent of the samples. For specific conductance greater than 550 umhos, the water was mixed type. Even though the water had no predominant ions for specific conductance greater than 550 umhos, the calcium ratio was the greatest of the cations. The chloride ion ratio increased for specific conductance greater than 550 umhos.

TREND.--The plots of dissolved solids, hardness, sulfate, and chloride concentrations versus time did not indicate any trend. The Spearman's rhos for the constituents also indicated no trend at the 95-percent probability level.

PUBLIC WATER SUPPLY.--The average hardness was 146 mg/L and the water was hard. Hardness concentrations of 121 to 180 mg/L, hard class, occurred for 59 percent of the hardness values and concentrations greater than 180 mg/L, very hard class, occurred for 13 percent of the values. The recommended maximum pH of 9.0 was exceeded by less than 1 percent of the pH values and the recommended maximum chloride concentration of 250 mg/L was exceeded by less than 1 percent of the chloride values. The recommended maximum iron concentration of 300 ug/L was exceeded by 6 percent of the iron values. The maximum cadmium contaminant level of 10 ug/L was exceeded by 12 percent of the cadmium values and the maximum lead contaminant level of 50 ug/L was exceeded by 6 percent of the lead values. Because the maximum cadmium and lead contaminant levels were exceeded, this water may not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with 92 percent of the samples having a medium salinity hazard. The sodium hazard was in the low class for all SAR values. No boron data were available.

07178620 - Verdigris River at Newt Graham Lock and Dam, near Inola, Okla.--Continued

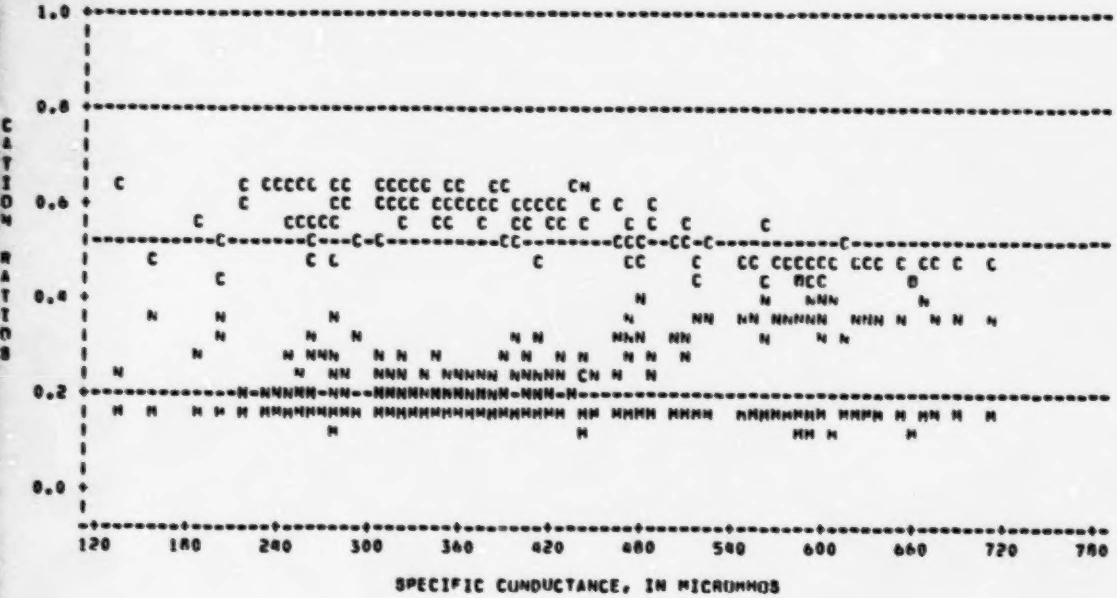
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	302	409	132	742	124	0.41	-0.47
Dissolved solids	221	248	88	887	83	2.41	15.22
pH	243	7.8	5.4	9.2	0.5	-.90	2.99
Total hardness	222	146	47	270	37	-.00	.36
Chloride	223	43	7.6	320	31	3.79	28.31
Sulfate	219	36	12	120	14	1.46	5.57
Iron	17	82	10	410	106	2.32	5.48
Fluoride	55	0.3	0.1	0.6	0.1	.67	.30
Arsenic	17	2	0	3	1.0	.33	-.97
Cadmium	17	3	0	14	4.1	2.08	3.28
Chromium	17	2	0	10	3.9	1.87	1.67
Lead	17	9	0	66	16	3.41	12.77
Mercury	17	0.0	0.0	0.3	0.1	2.38	4.44
SAR	210	0.9	0.4	5.5	0.5	4.23	35.39
Boron	0						

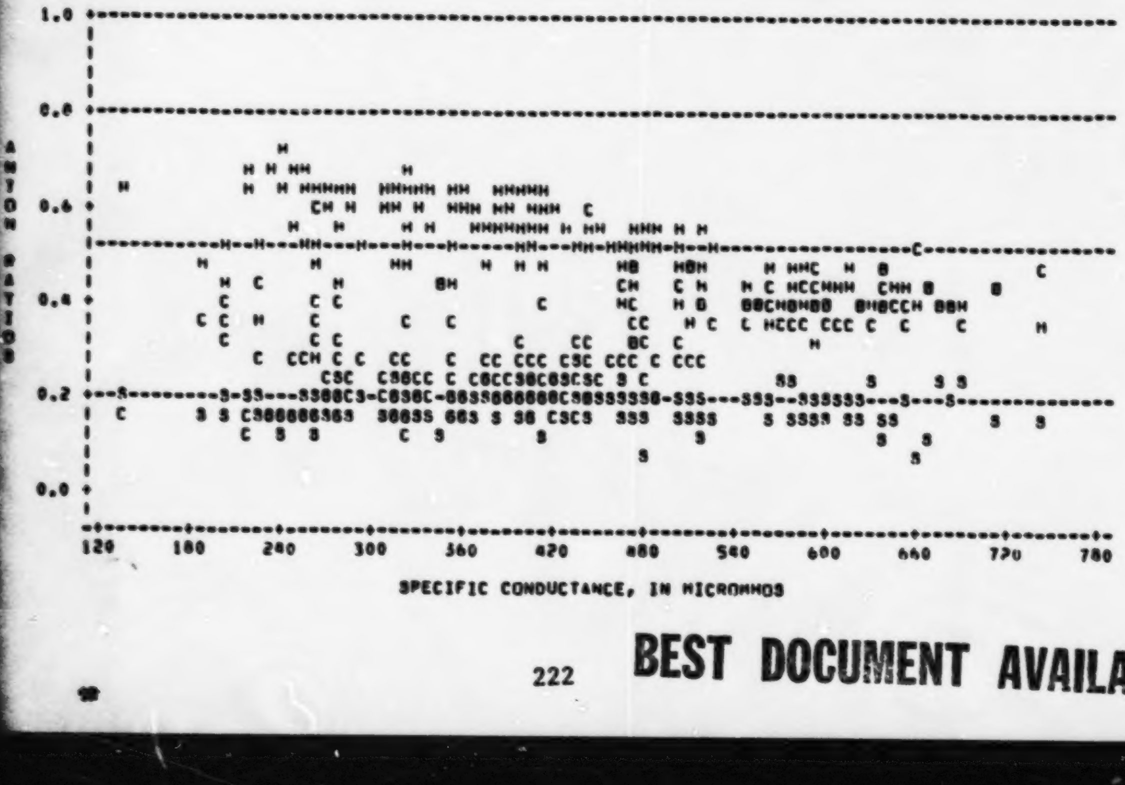
FREQUENCY DISTRIBUTION

	PERCENTILE CONCENTRATION				
CONSTITUENT	10th	25th	50th	75th	90th
Specific conductance	263	318	395	485	590
Dissolved solids	165	195	232	290	351
pH	7.2	7.6	7.8	8.1	8.3
Total hardness	97	120	150	170	187
Chloride	20	24	31	56	83
Sulfate	22	26	34	44	52
Iron	10	20	32	97	169
Fluoride	0.1	0.2	0.3	0.3	0.4
Arsenic	0	1	1	2	3
Cadmium	0	1	1	2	9
Chromium	0	0	0	0	10
Lead	0	1	4	10	15
Mercury	0.0	0.0	0.0	0.0	0.2
SAR	0.5	0.6	0.7	1.1	1.5
Boron					

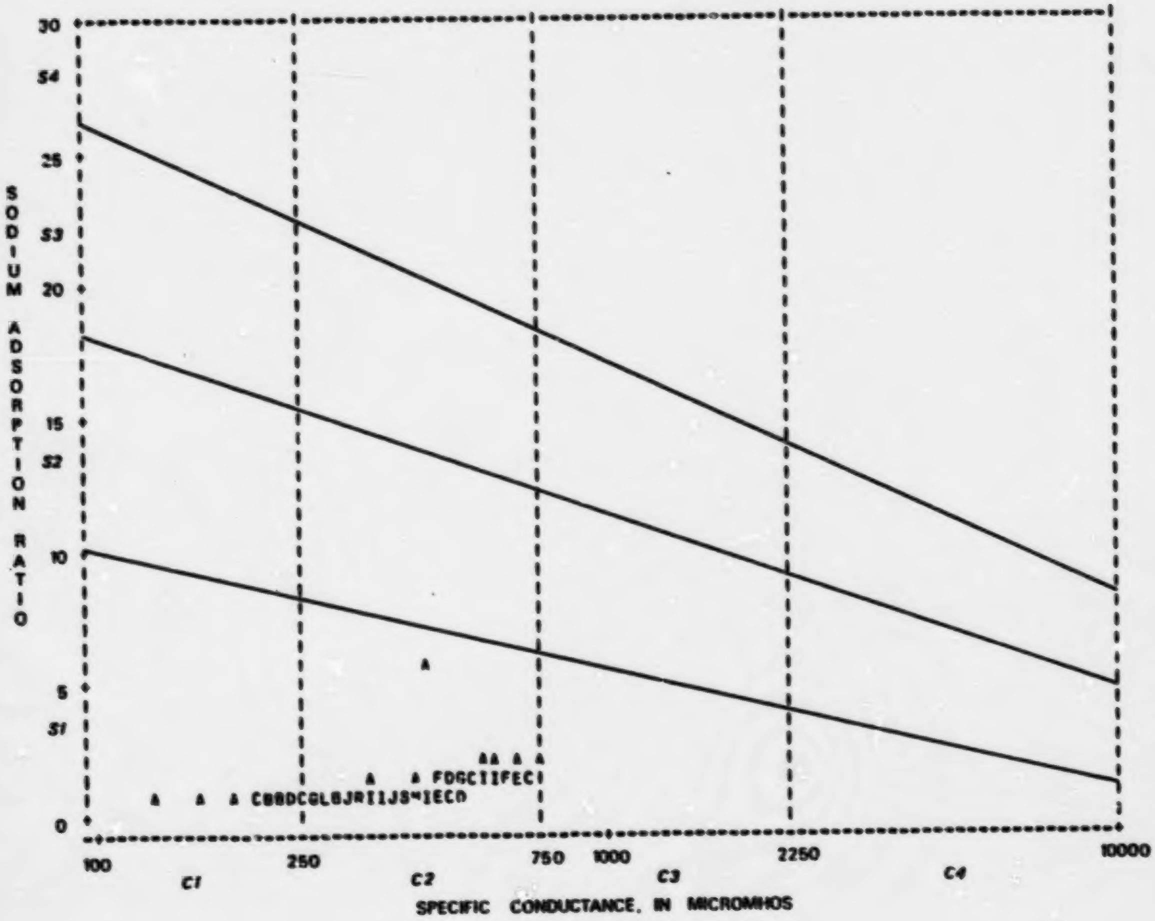
CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER (NEWT GRAHAM L&D) NEAR INOLA, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER (NEWT GRAHAM L&D) NEAR INOLA, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER (NEWT GRAHAM L&D) NEAR INOLA, OK



BEST DOCUMENT AVAILABLE

VERDIGRIS RIVER BASIN

07178670 - Verdigris River near Okay, Okla.

LOCATION.--Lat 36°50'50", long 95°19'25", in NW¼SE¼ sec.19, T.16 N., R.19 E., Wagoner County, at bridge on State Highway 16, 0.5 mi southwest of Okay.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1952 to 1953, 1960 to 1963.

WATER TYPE.--The water was calcium carbonate/bicarbonate type for specific conductance equal to or less than 600 umhos, which occurred in 44 percent of the samples. For specific conductance greater than 600 umhos, chloride was predominant. The data suggest the cation sodium could become predominant when specific conductance becomes greater than 1,000 umhos.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 192 mg/L and the water was very hard. Hardness concentrations were greater than 180 mg/L, very hard class, for 58 percent of the samples. None of the constituents exceeded recommended maximum concentrations. No toxic element data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from medium to high with 79 percent of the samples having a medium salinity hazard. The sodium hazard was in the low class for all SAR values. No boron data were available.

07178670 - Verdigris River near Okay, Okla.--Continued

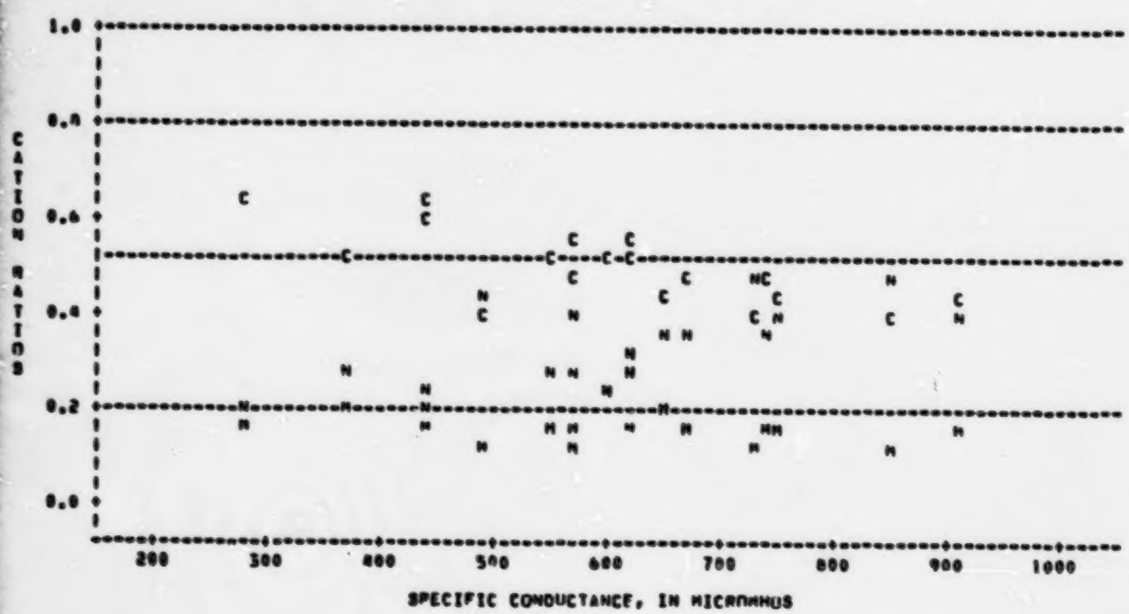
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	43	622	250	1040	190	0.06	-0.47
Dissolved solids	40	379	157	576	115	-.10	-.90
pH	43	8.2	7.7	8.6	0.2	-.69	-.24
Total hardness	43	192	88	300	49	-.05	-.33
Chloride	43	98	19	235	49	.75	.48
Sulfate	41	38	14	76	16	.47	-.60
Iron	0						
Fluoride	2	0.2	0.1	0.3			
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	41	1.6	0.5	3.5	0.7	.61	.57
Boron	0						

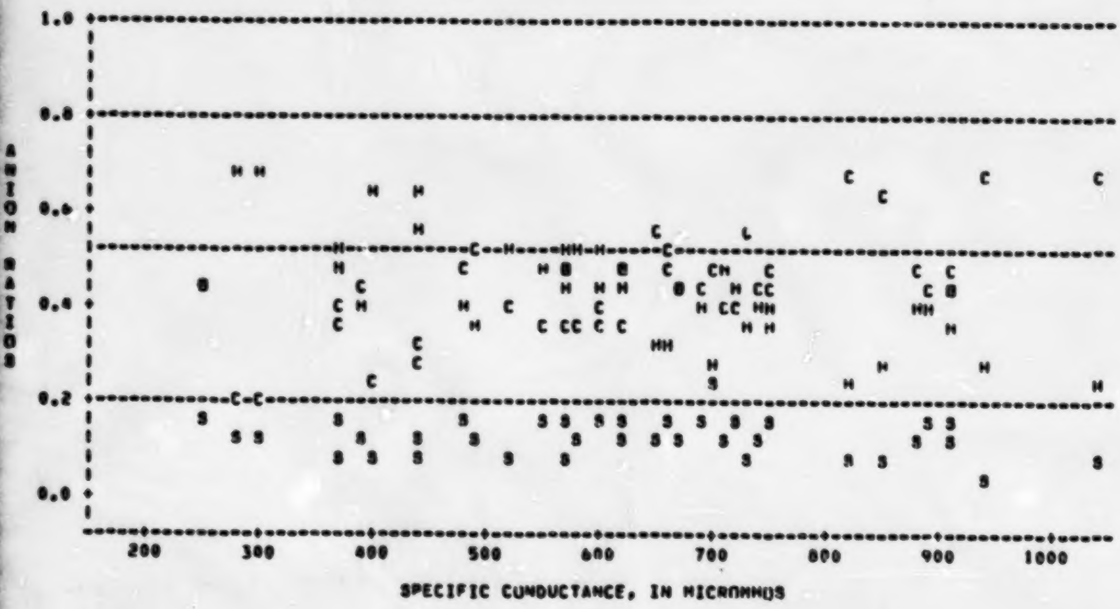
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	368	467	612	736	885
Dissolved solids	213	303	375	464	537
pH	7.8	8.1	8.2	8.4	8.5
Total hardness	117	159	191	222	251
Chloride	40	62	90	119	158
Sulfate	17	23	34	49	57
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.7	1.0	1.6	1.9	2.5
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR OKAY, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR OKAY, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=VERDIGRIS RIVER NR OKAY, OK
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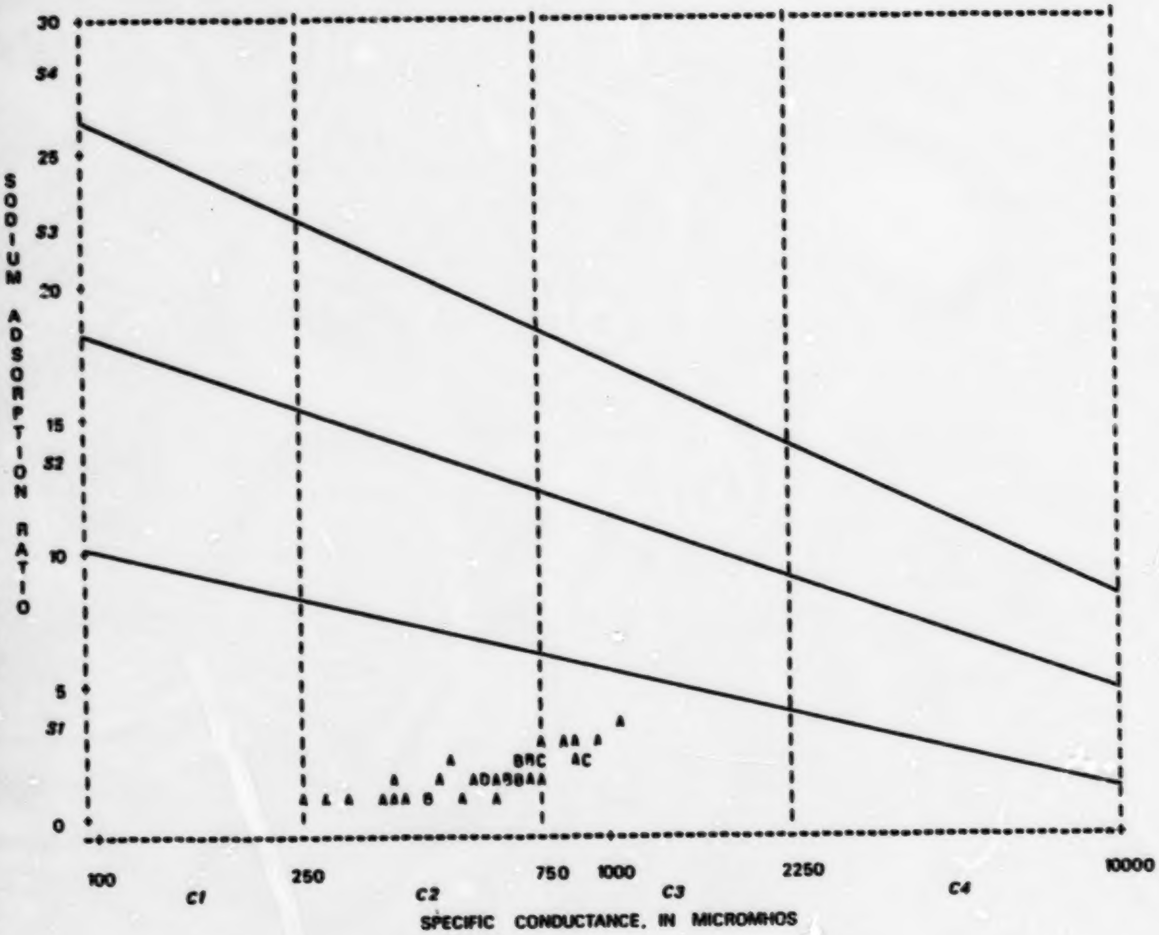


07191000 - Big Cabin Creek near Big Cabin, Okla.

LOCATION.--Lat 36°34'06", long 95°09'97", in NE¼NE¼ sec.15, T.24 N., R.20 E., Craig County, at county road bridge, 4.9 mi northeast of Big Cabin, 0.9 mi downstream from White Oak Creek, 6.8 mi upstream from Mustang Creek, and at mile 13.0.

DRAINAGE AREA.--450 mi^2.

PERIOD OF RECORD.--1951 to 1960, 1964 to 1971.

WATER TYPE.--The water type varied with the specific conductance. For specific conductance less than or equal to 400 umhos, which occurred in 69 percent of the samples, the water was calcium bicarbonate type, and for specific conductance between 400 and 500 umhos, 17 percent of the samples, the water was calcium sulfate type. Data from specific conductance greater than 500 umhos indicate the water was sodium type. No anion data were available for the larger specific conductance.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 143 mg/L and the water was hard. Hardness concentrations were greater than 120 mg/L for 71 percent of the hardness values, and greater than 180 mg/L, very hard class, for 18 percent of the values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 1 percent of the chloride values and the recommended maximum sulfate concentration of 250 mg/L was exceeded by 1 percent of the sulfate values. Lead concentration data indicate that this toxic element should not exceed its maximum contaminant level. No other toxic metal data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to high with 85 percent of the samples in the medium salinity hazard class. The sodium hazard was low class for all but one SAR value which was in the medium sodium hazard class. No boron data were available.

07191000 - Big Cabin Creek near Big Cabin, Okla.--Continued

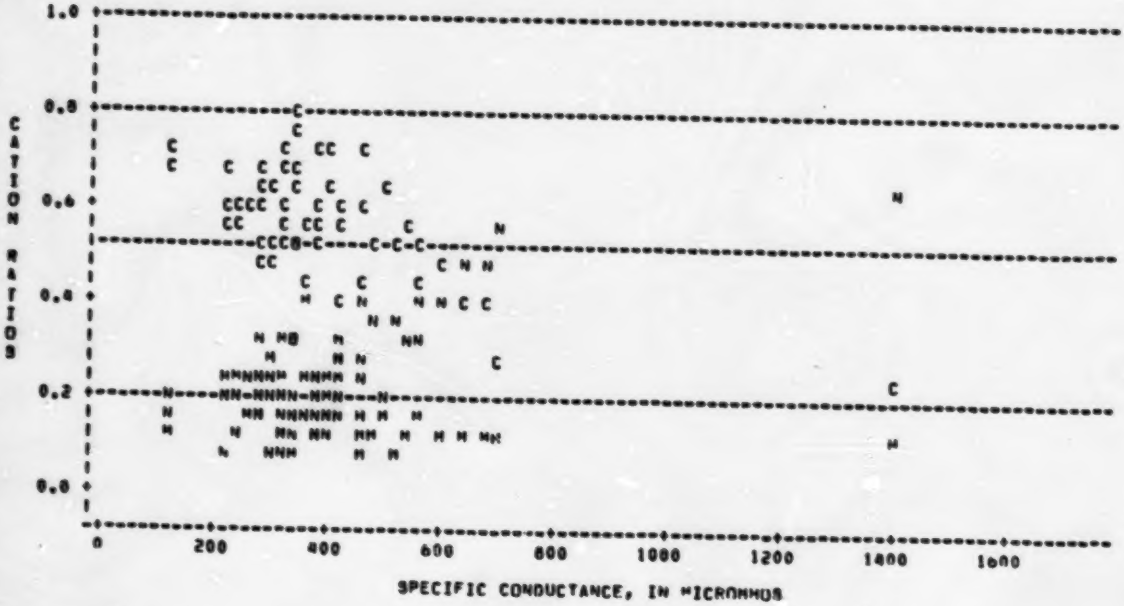
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	183	371	77	1410	148	2.17	13.00
Dissolved solids	90	229	48	435	83	.22	.12
pH	172	7.5	6.1	8.2	0.4	-.71	.13
Total hardness	154	143	21	282	48	-.15	.48
Chloride	164	19	2.4	325	31	6.51	56.80
Sulfate	109	77	11	275	45	1.32	2.95
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	12	2	0	10	4.5	1.33	-.33
Mercury	0						
SAR	127	0.7	0.2	7.2	0.9	5.25	33.20
Boron	0						

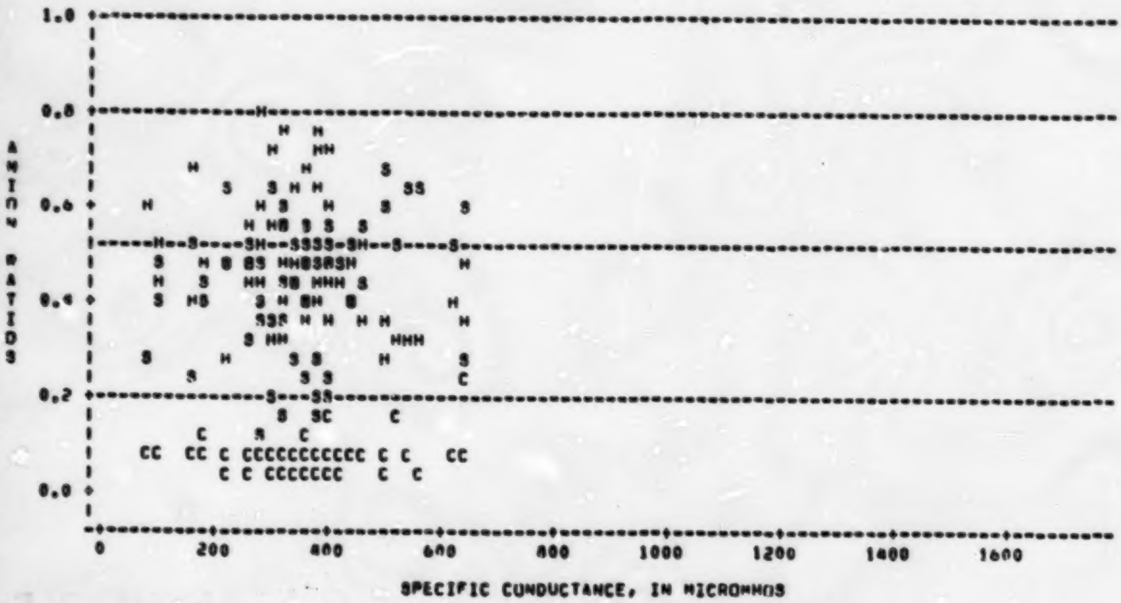
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	213	289	353	420	529
Dissolved solids	123	176	229	274	329
pH	6.8	7.2	7.5	7.8	7.9
Total hardness	78	117	143	171	195
Chloride	5.7	7.8	10	15	45
Sulfate	33	41	71	97	133
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead	0	0	0	0	6
Mercury					
SAR	0.3	0.4	0.5	0.7	1.3
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BIG CABIN CREEK NR BIG CABIN, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BIG CABIN CREEK NR BIG CABIN, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=BIG CABIN CREEK NR BIG CABIN, OK
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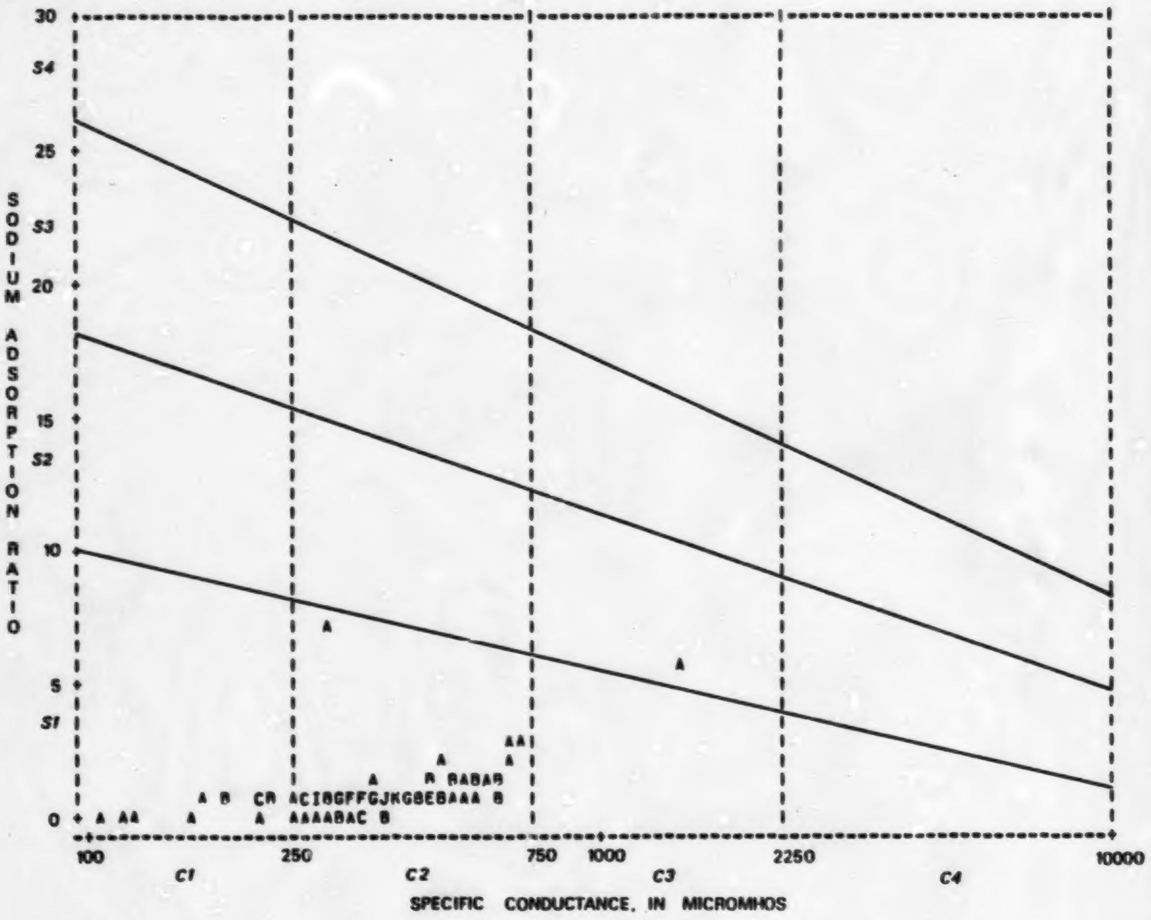


BEST DOCUMENT AVAILABLE

NEOSHO RIVER BASIN

07189000 - Elk River near Tiff City, Mo.

LOCATION.--Lat 36°37'50", long 94°35'12", in NE¼ sec.22, T.22 N., R.34 W., McDonald County, at bridge on State Highway 43, 0.8 mi downstream from Blackfoot Branch, 2.8 mi upstream from Buffalo Creek, 3.0 mi southeast of Tiff City, and at mile 15.8.

DRAINAGE AREA.--872 mi^2.

PERIOD OF RECORD.--1948 to 1949, 1951 to 1958, 1960 to 1961, 1976 to 1977.

WATER TYPE.--The water was calcium carbonate/bicarbonate type throughout the range of specific conductance. The calcium and carbonate/bicarbonate ion ratios were greater than 75 percent.

TREND.--The current period of record is insufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 125 mg/L and the water was hard. Hardness concentrations were greater than 120 mg/L for 65 percent of the hardness values. Recommended maximum concentrations were not exceeded by any of the constituents. Cadmium, chromium, and lead did not exceed the maximum contaminant levels. No data were available for arsenic and mercury. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with 61 percent of the samples having a medium salinity hazard. The sodium hazard was in the low class for all SAR values. No boron data were available.

07189000 - Elk River near Tiff City, Mo.--Continued

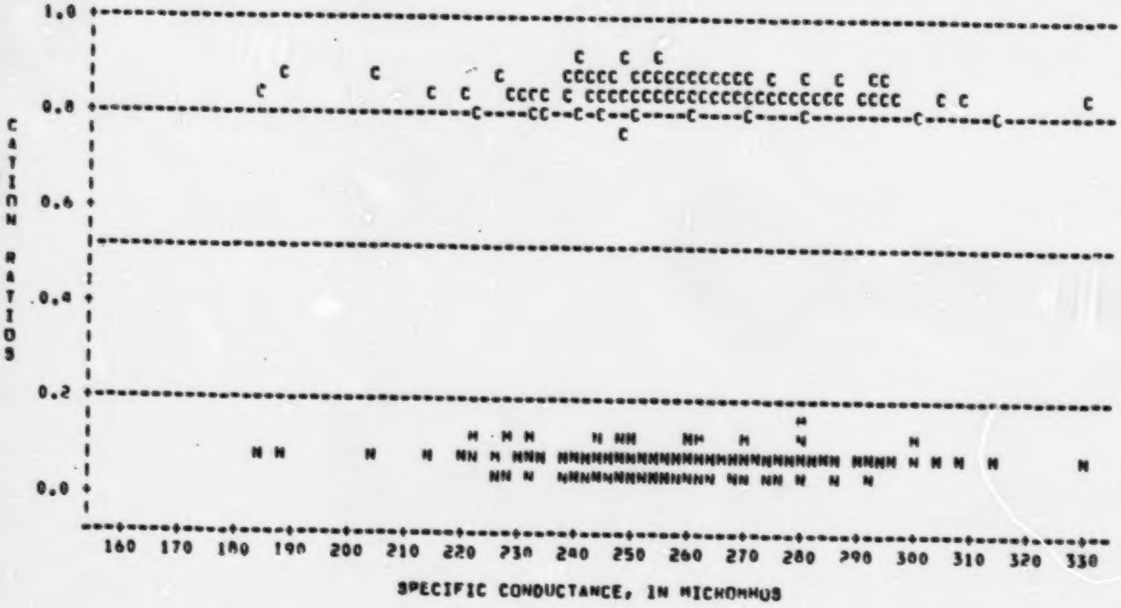
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	254	257	183	330	23	0.01	1.00
Dissolved solids	199	151	115	186	12	-.01	.05
pH	211	8.0	6.6	8.6	0.3	-.95	1.96
Total hardness	252	125	84	152	11	-.54	1.45
Chloride	251	5.4	0.3	23	2.8	3.20	14.50
Sulfate	214	6.0	1.2	27	2.2	4.57	38.69
Iron	70	24	0	160	27	2.56	9.25
Fluoride	154	0.1	0.0	1.4	0.1	6.46	57.91
Arsenic	0						
Cadmium	1	1					
Chromium	1	2					
Lead	1	6					
Mercury	0						
SAR	155	0.1	0.1	0.3	0.1	.75	-.64
Boron	0						

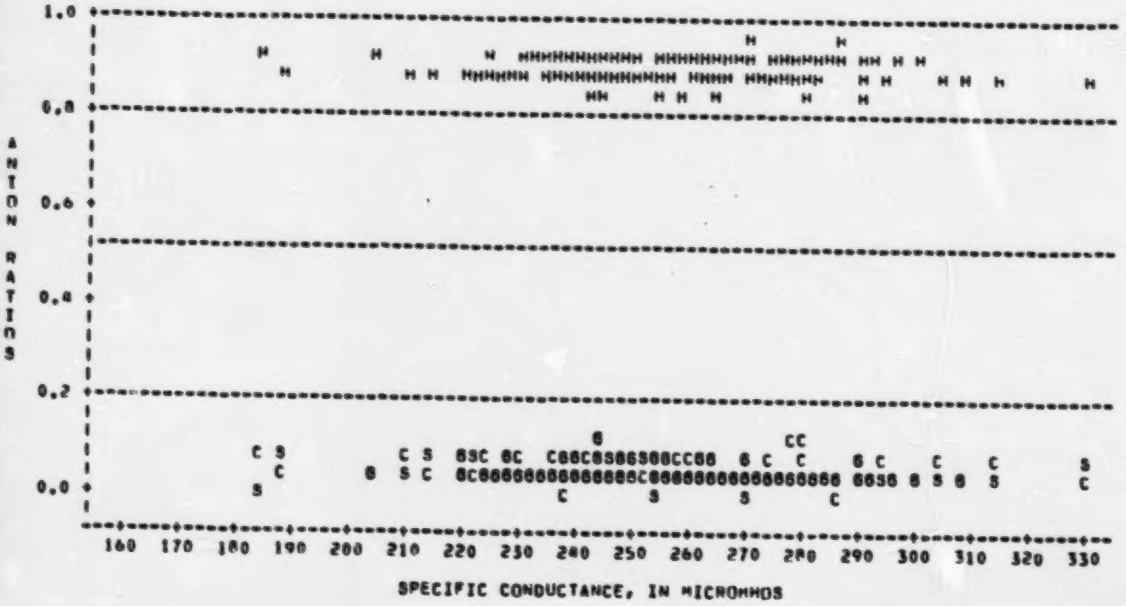
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	232	243	255	270	286
Dissolved solids	136	142	150	159	167
pH	7.5	7.7	8.0	8.1	8.3
Total hardness	111	119	125	130	137
Chloride	3.2	4.0	5.0	5.9	8.1
Sulfate	4.3	4.8	5.8	6.6	7.7
Iron	0	10	20	30	54
Fluoride	0.0	0.0	0.0	0.1	0.2
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.0	0.1	0.1	0.2	0.2
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ELK RIVER NR TIFF CITY, MO



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ELK RIVER NR TIFF CITY, MO



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARF HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=ELK RIVER NR TIFF CITY, MO
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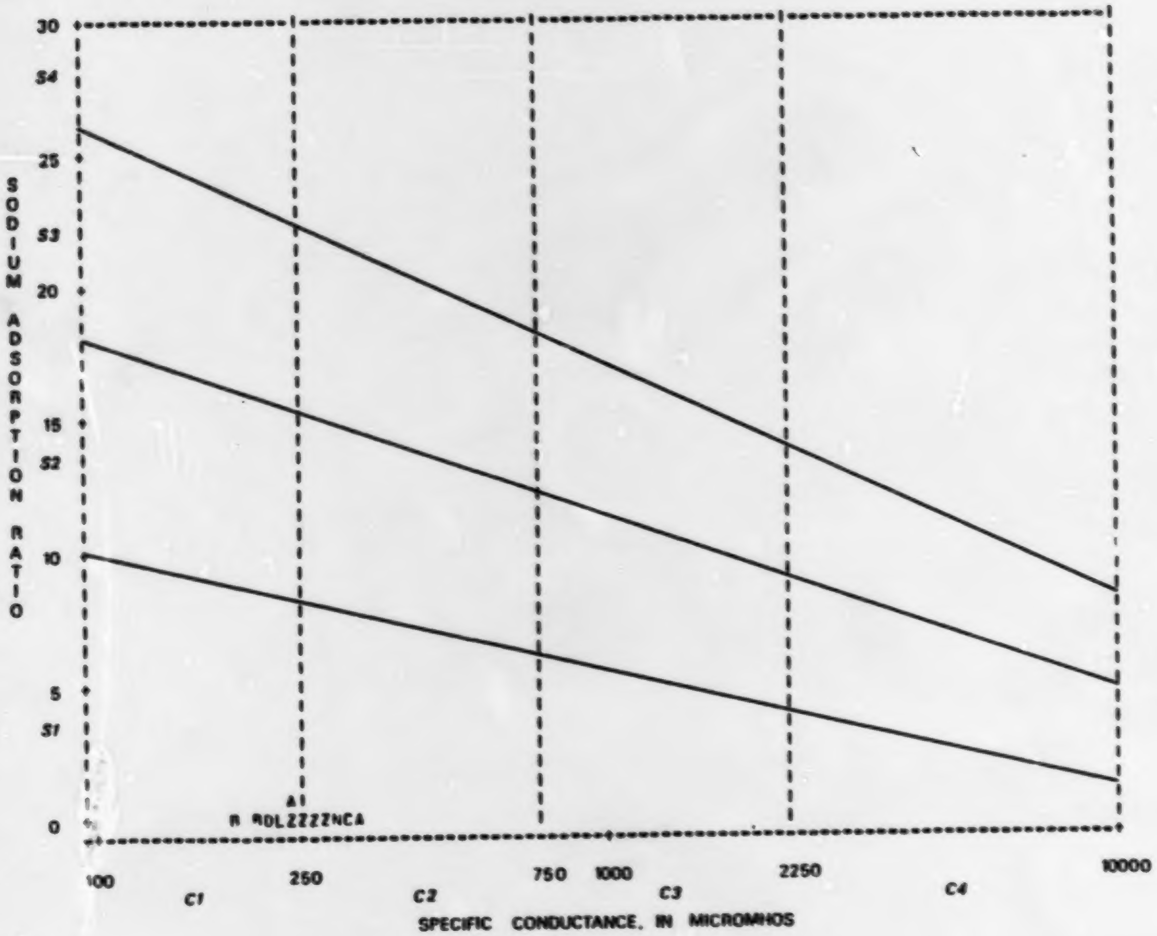


BEST DOCUMENT AVAILABLE

07188500 - Lost Creek at Seneca, Mo.

LOCATION.--Lat 36°50'25", long 94°36'40", in SE¼SE¼ sec. 35, T.25 N., R.34 W., Newton County, at bridge on State Highway 43 in Senca, 0.4 mi upstream from Little Lost Creek, and 9.5 mi upstream from mouth.

DRAINAGE AREA.--42 mi^2.

PERIOD OF RECORD.--1951 to 1958.

WATER TYPE.--The water was calcium carbonate/bicarbonate type for all measured specific conductances. The calcium and the carbonate/bicarbonate ion ratios were greater than 80 percent.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 116 mg/L and the water was moderately hard. Hardness concentrations were less than 120 mg/L for 50 percent of the hardness values. Recommended maximum concentrations were not exceeded by any of the constituents. No toxic element data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with 51 percent of the samples in the medium salinity hazard class. The sodium hazard was in the low class for all SAR vaues. No boron data were available.

07188500 - Lost Creek at Seneca, Mo.--Continued

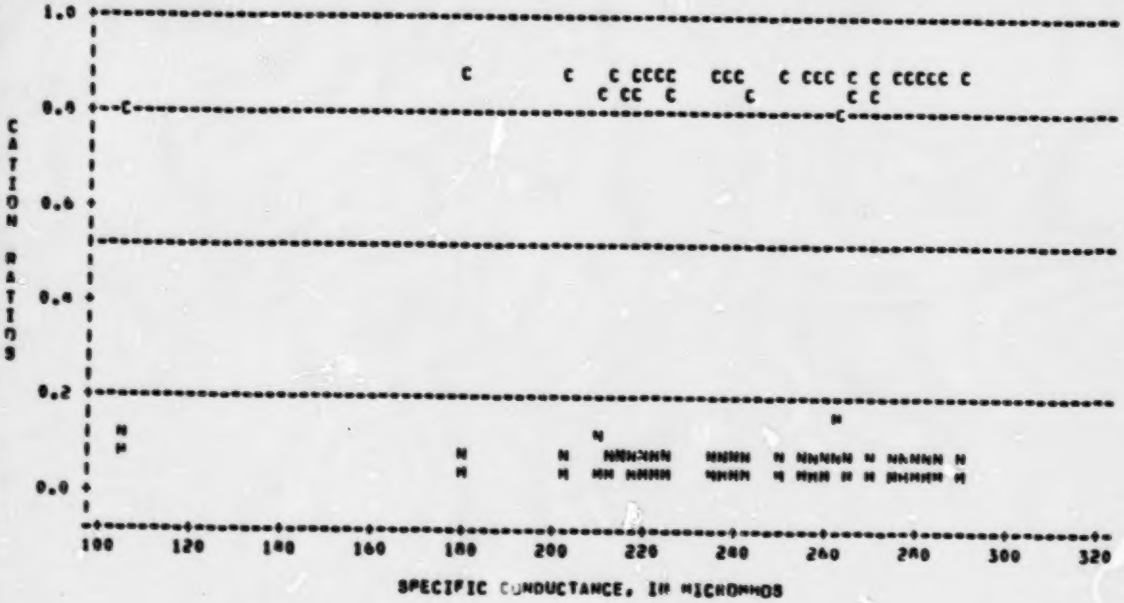
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	49	246	104	290	34	-1.57	4.80
Dissolved solids	49	145	76	170	19	-1.28	2.46
pH	49	8.0	7.0	8.7	0.3	-.63	.98
Total hardness	49	116	46	142	18	-1.31	3.62
Chloride	49	4.5	1.4	9.4	1.5	1.15	2.21
Sulfate	49	7.8	4.0	11	1.4	.29	1.37
Iron	35	23	0	140	30	2.68	8.04
Fluoride	49	0.1	0.0	0.2	0.1	.84	-.31
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	48	0.1	0.1	0.2	0.1	.63	-1.68
Boron	0						

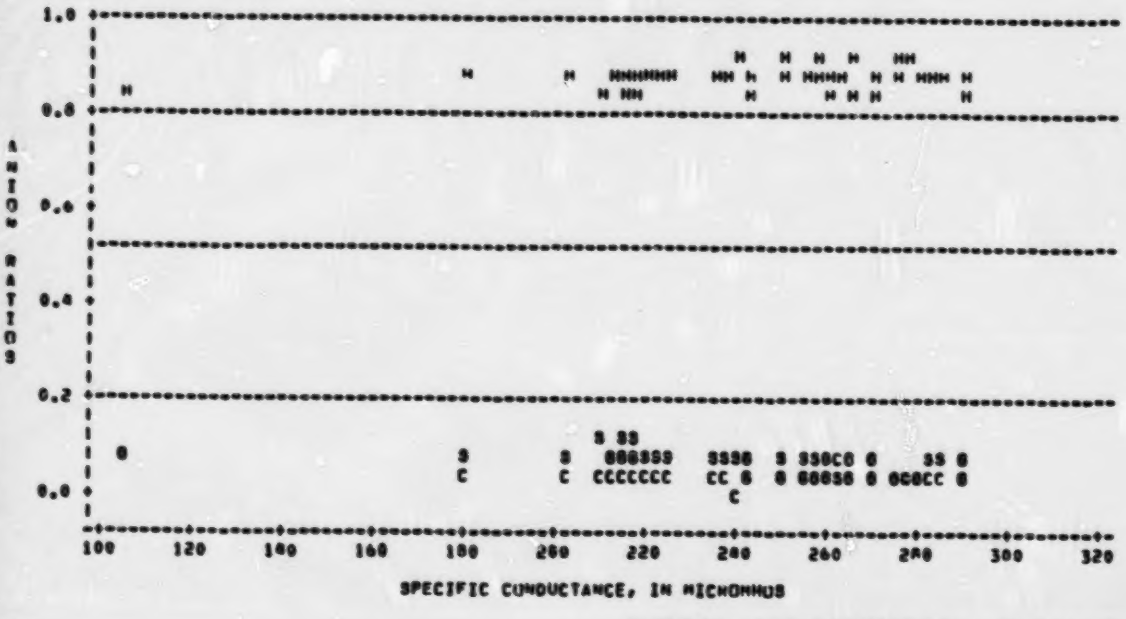
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	212	219	252	269	280
Dissolved solids	122	131	150	159	164
pH	7.5	7.7	8.0	8.2	8.3
Total hardness	95	106	119	129	133
Chloride	3.1	3.6	4.0	5.0	6.2
Sulfate	6.4	7.1	7.6	8.2	9.3
Iron	0	5	10	30	42
Fluoride	0.0	0.0	0.0	0.1	0.1
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.0	0.1	0.1	0.1	0.2
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=LOST CREEK AT SENECA, MO.



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=LOST CREEK AT SENECA, MO.



BEST DOCUMENT AVAILABLE

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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=LOST CREEK AT SENECA, MD.
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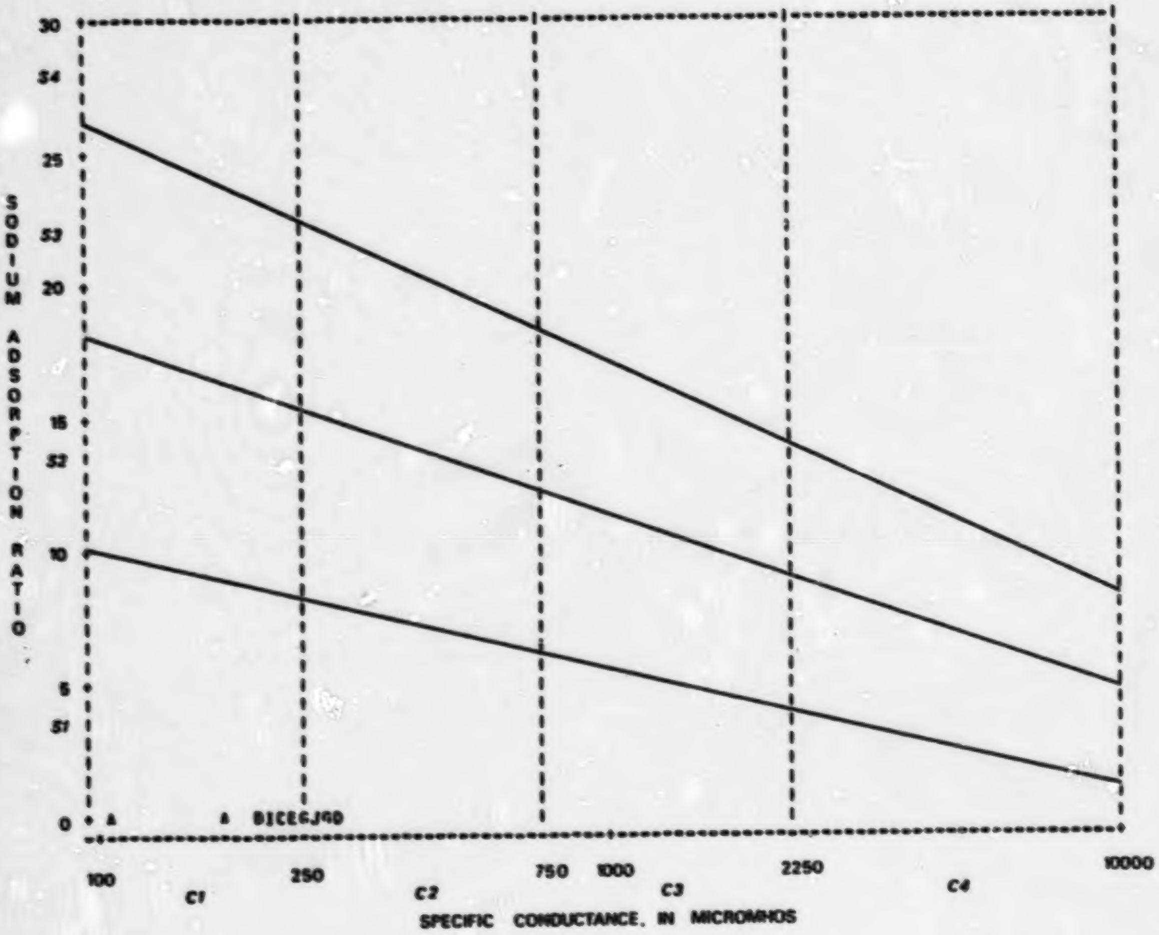


BEST DOCUMENT AVAILABLE

07185000 - Neosho River near Commerce, Okla.

LOCATION.--Lat 36°55'43", long 94°57'26", in SW¼SE¼ sec.5, T.28 N., R.22 E., Ottawa County, at county road bridge, 1.3 mi upstream from Mud Creek, 2.2 mi downstream from Fourmile Creek, 4.5 mi west of Commerce, and at mile 153.4.

DRAINAGE AREA.--5,876 mi^2.

PERIOD OF RECORD.--1948 to 1954, 1960 to 1973, 1976 to 1978.

WATER TYPE.--The water was calcium carbonate/bicarbonate type for specific conductance less than or equal to 1,000 umhos, which occurred in 99 percent of the samples. In the 1 percent of the samples where the specific conductance was greater than 1,000 umhos, the water was mixed type with a trend toward increasing chloride and sodium.

TREND.--Plots of the chloride and hardness concentrations versus time indicate no trend. A possible negative trend was indicated by the sulfate concentration versus time plot. The Spearman's rhos at the 95-percent probability level also indicate no trend for chloride and hardness and a negative trend for sulfate. No current data were available for the dissolved solids.

PUBLIC WATER SUPPLY.--The average hardness was 203 mg/L and the water was very hard. For 58 percent of the hardness values, the concentration was greater than 180 mg/L, very hard class. The recommended maximum sulfate concentration of 250 mg/L was exceeded by less than 1 percent of the sulfate values. Data indicate that lead concentrations should not exceed the maximum contaminant level of 50 ug/L. No other toxic metal data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to high with less than 6 percent of the samples having a high salinity hazard. The sodium hazard was in the low class for all of the SAR values. The data indicate phytotoxic effects from boron should not occur.

07185000 - Neosho River near Commerce, Okla.--Continued

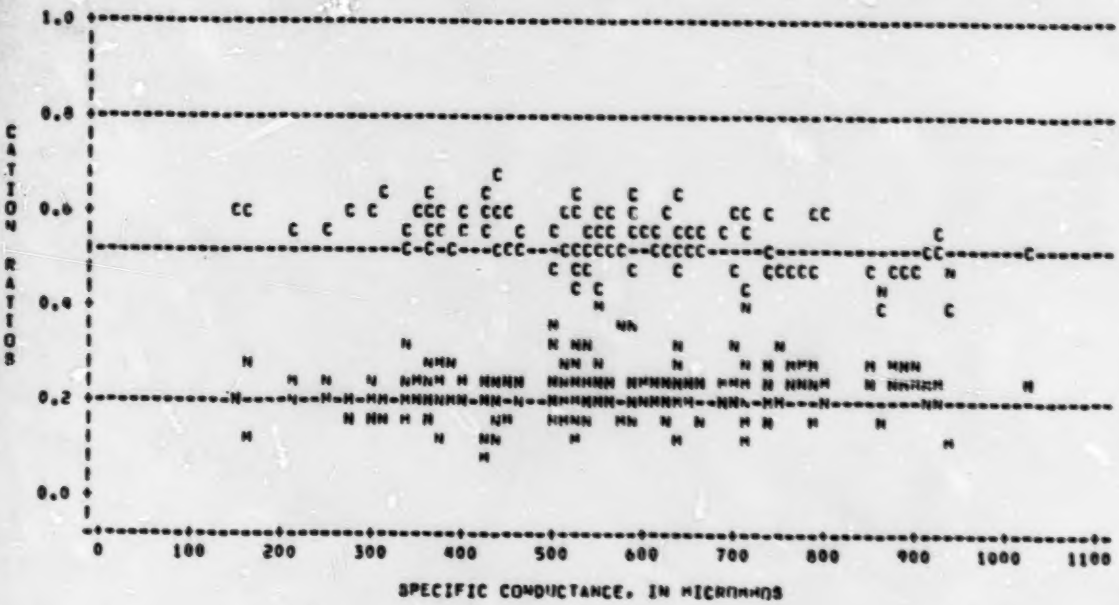
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	694	476	130	1080	170	0.57	0.45
Dissolved solids	558	306	102	690	110	.76	.40
pH	507	7.9	6.2	9.0	0.4	-.59	.94
Total hardness	593	203	51	535	76	.56	.49
Chloride	596	26	1.0	158	20	2.10	6.38
Sulfate	624	77	12	358	43	1.35	3.47
Iron	9	17	0	80			
Fluoride	79	0.2	0.0	0.7	0.1	.47	.44
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	12	2	0	20	6.2	2.56	6.24
Mercury	0						
SAR	243	0.8	0.1	2.9	0.4	1.78	5.72
Boron	36	230	0	570	153	.60	-.42

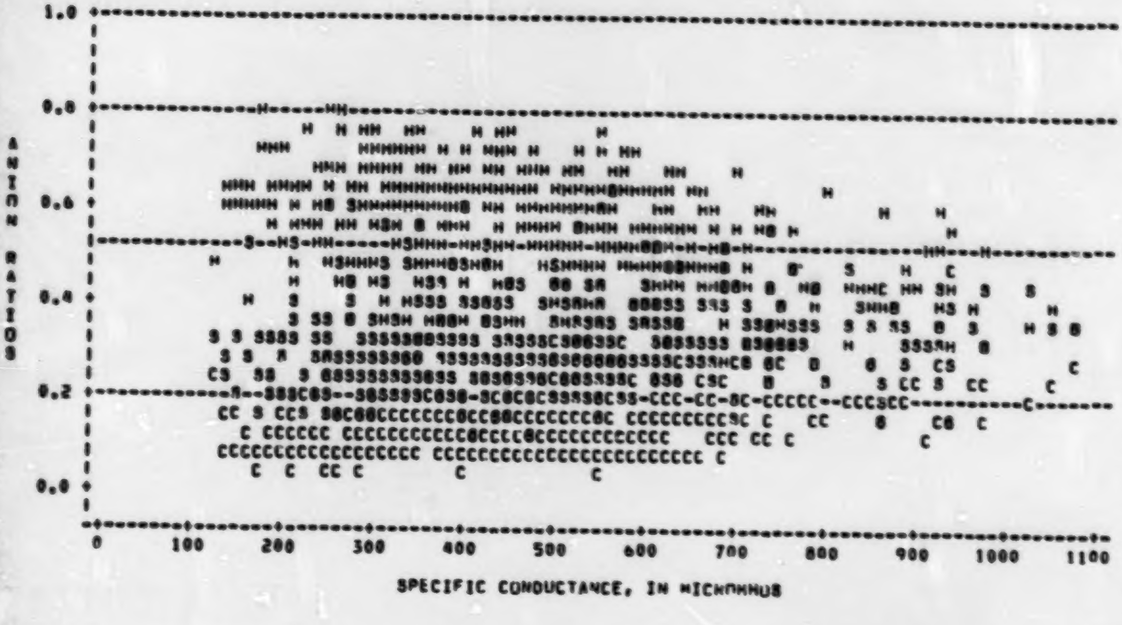
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	264	356	464	576	686
Dissolved solids	176	224	294	374	456
pH	7.4	7.6	7.9	8.1	8.3
Total hardness	108	149	200	250	300
Chloride	8.5	13	19	32	54
Sulfate	31	46	67	100	133
Iron					
Fluoride	0.0	0.0	0.3	0.3	0.4
Arsenic					
Cadmium					
Chromium					
Lead	0	0	0	0	8
Mercury					
SAR	0.4	0.5	0.7	1.0	1.2
Boron	33	130	190	315	468

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=NEOSHO RIVER NR COMMERCE, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=NEOSHO RIVER NR COMMERCE, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=NEOSHO RIVER NR COMMERCE, OK
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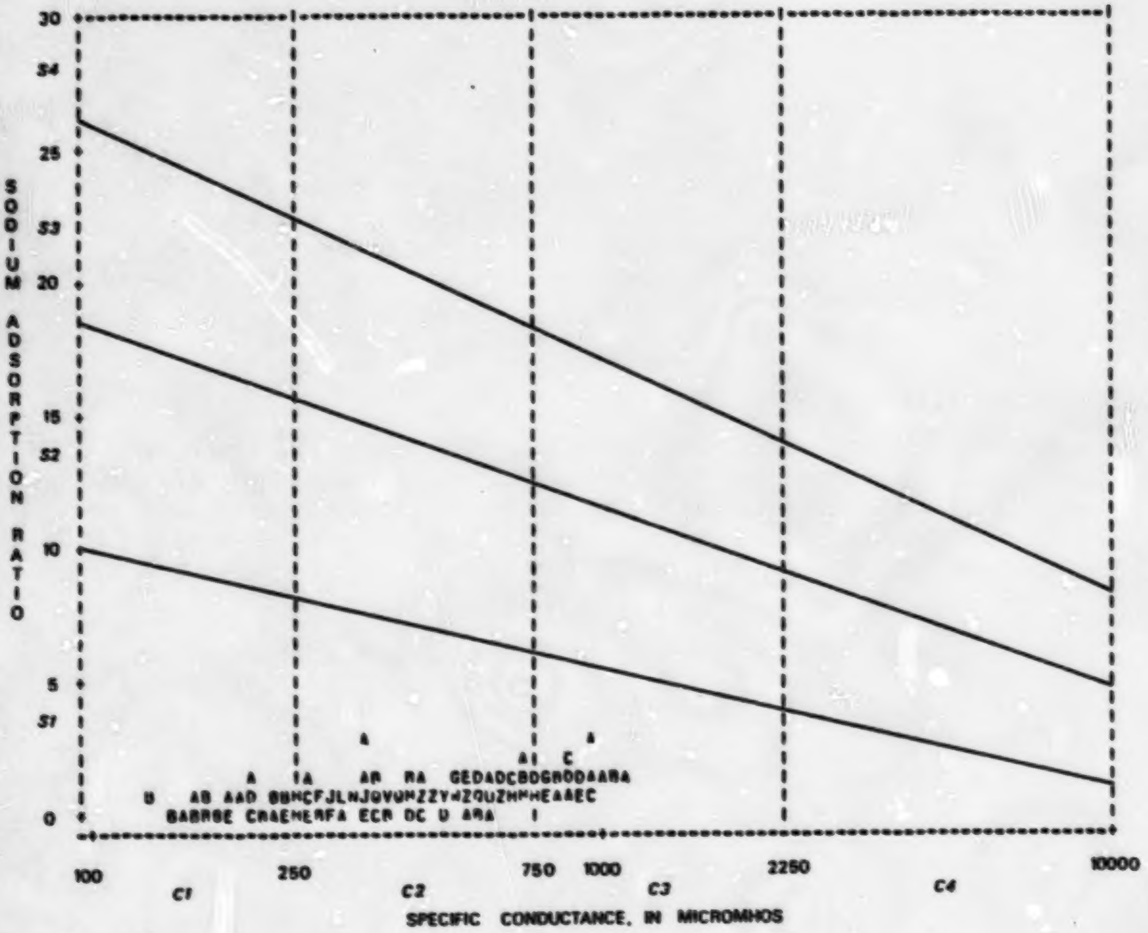


BEST DOCUMENT AVAILABLE

NEOSHO RIVER BASIN

07190500 - Neosho River near Langley, Okla.

LOCATION.--Lat 36°26'15", long 95°02'44", in SE¼ sec.27, T.23 N., R.21 E., Mayes County, at bridge on State Highway 82, 1.5 mi south of Langley, 4.1 mi downstream from Pensacola Dam, 5.8 mi upstream from Big Cabin Creek, and at mile 72.9.

DRAINAGE AREA.--10,355 mi^2, at gaging station 0.5 mi upstream.

PERIOD OF RECORD.--1950 to 1959, 1976 to 1978.

WATER TYPE.--The water was calcium carbonate/bicarbonate type for specific conductance less than 375 umhos, which occurred in 99 percent of the samples. For the samples where the specific conductance was greater than 375 umhos, the carbonate/bicarbonate ion ratio was less than 50 percent. No cation ratio data were available for specific conductance greater than 375 umhos.

TREND.--The current data period of record is not sufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 129 mg/L and the water was hard. Hardness concentrations less than 120 mg/L occurred for 27 percent of the hardness values. None of the constituents exceeded recommended maximum concentrations. No toxic metal data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with 78 percent of the samples in the medium salinity hazard class. The sodium hazard was in the low class for all SAR values. The data indicate that phytotoxic effects from boron should not occur.

07190500 - Neosho River near Langley, Okla.--Continued

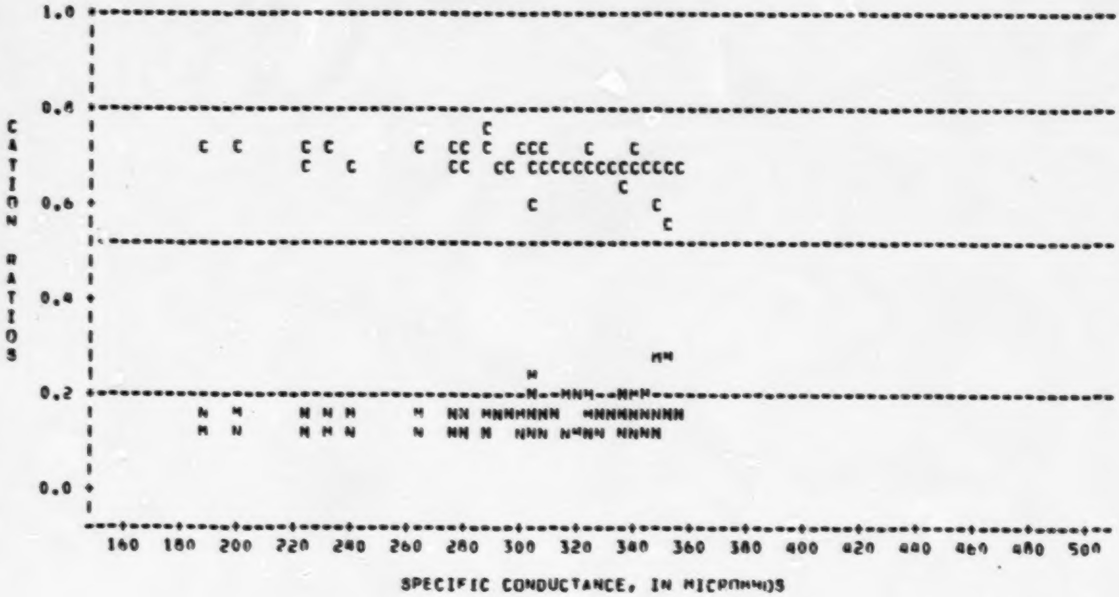
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	129	293	188	508	46	0.39	2.63
Dissolved solids	89	183	128	293	28	.39	1.75
pH	120	7.4	6.7	8.7	0.4	.36	.19
Total hardness	117	129	78	227	21	.36	3.03
Chloride	125	12	1.0	85	9.8	5.18	32.25
Sulfate	113	38	7.0	88	12	.29	1.54
Iron	0						
Fluoride	42	0.3	0.0	0.6	0.1	.35	-.11
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	75	0.4	0.1	1.2	0.1	2.82	14.97
Boron	40	75	0	290	68	1.00	1.05

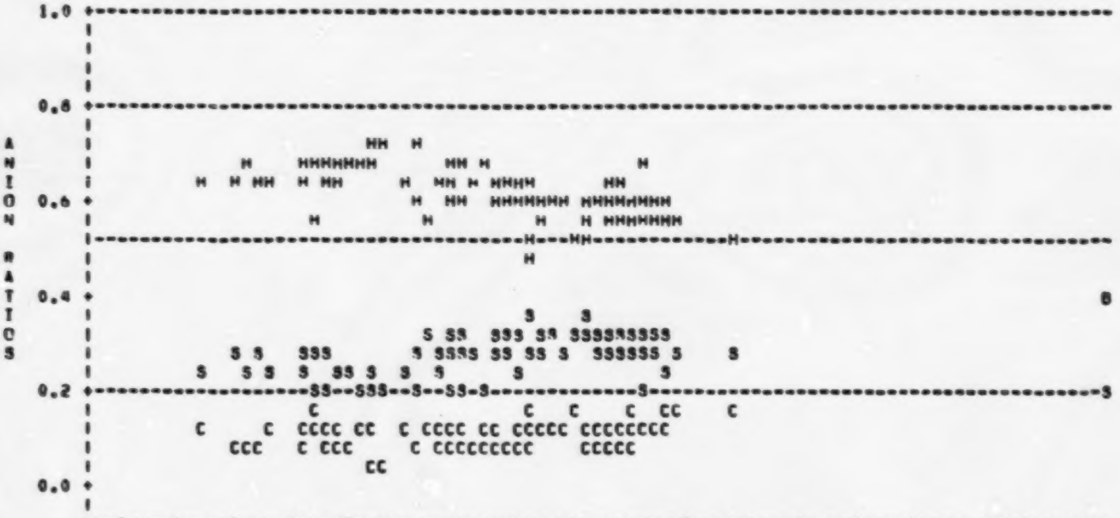
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	228	263	296	329	335
Dissolved solids	143	163	185	201	209
pH	6.9	7.2	7.4	7.7	8.0
Total hardness	100	116	130	144	150
Chloride	6.0	8.2	11	13	16
Sulfate	23	28	40	47	50
Iron					
Fluoride	0.0	0.1	0.3	0.3	0.4
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.3	0.3	0.3	0.4	0.5
Boron	0	10	53	110	160

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=NEUSHO RIVER NR LANGLEY, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=NEUSHO RIVER NR LANGLEY, OK



BEST DOCUMENT AVAILABLE

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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=NEOSHO RIVER NR LANGLEY, OK
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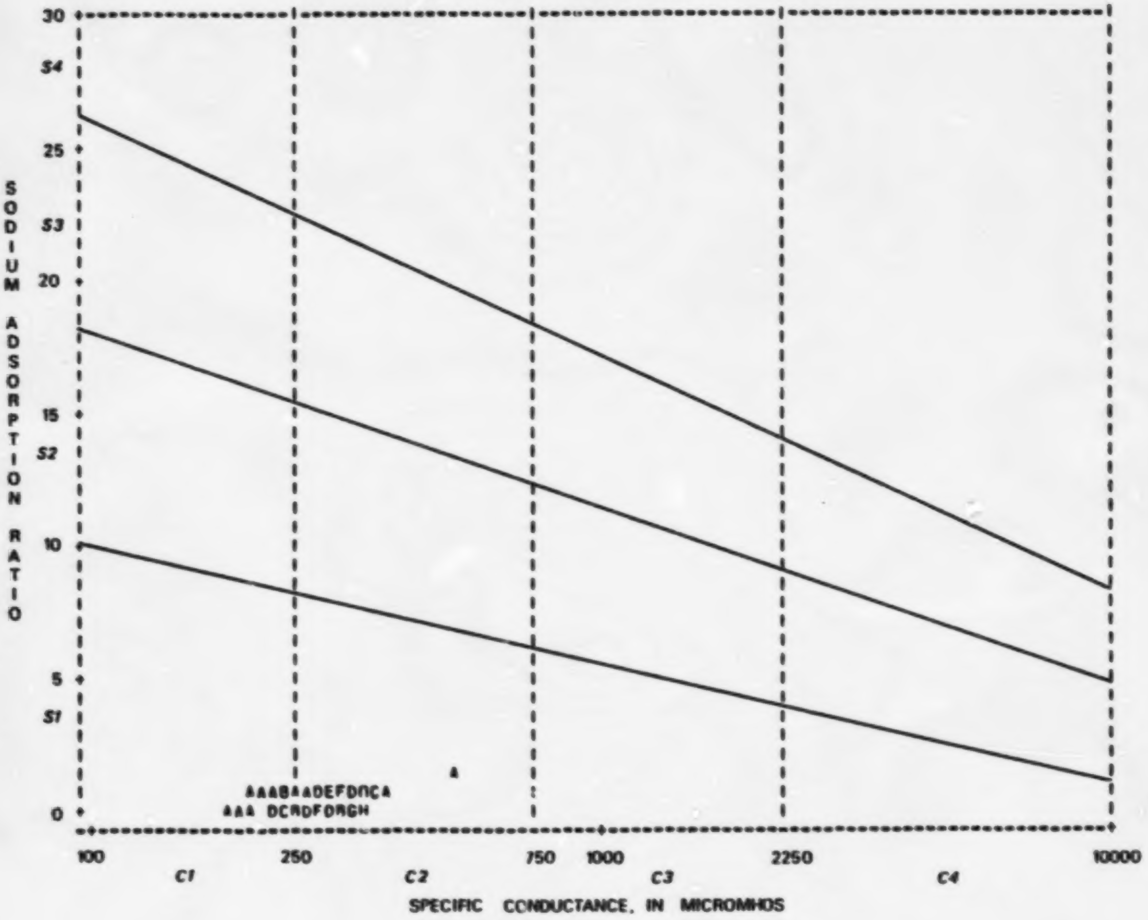


NEOSHO RIVER BASIN

07191500 - Neosho River near Choteau, Okla.

LOCATION.--Lat 36°13'45", long 95°10'59", in SE¼NW¼ sec.9, T.20 N., R.20 E., Mayes County, on left bank, 300 ft downstream from Robert S. Kerr Dam, 2.2 mi northwest of Locust Grove, 10 mi northeast of Choteau, and at mile 47.2.

DRAINAGE AREA.--11,534 mi^2.

PERIOD OF RECORD.--1952 to 1958, 1960, 1976 to 1978.

REMARKS.--Water quality samples were collected at county road bridge 2.5 mi downstream from gaging station.

WATER TYPE.--The water was calcium carbonate/bicarbonate type. The calcium and carbonate/bicarbonate ion ratios were greater than 50 percent throughout the range of measured specific conductance.

TREND.--The current period of record is not sufficient, less than 5 years, to perform trend analysis.

PUBLIC WATER SUPPLY.--The average hardness was 127 mg/L and the water was hard. Hardness concentrations were greater than 120 mg/L for 67 percent of the hardness values. The minimum recommended pH value of 5.0 was exceeded by less than 1 percent of the pH values. No toxic metal data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with 83 percent of the samples having a medium salinity hazard. The sodium hazard was in the low class for all SAR values. No boron data were available.

07191500 - Neosho River near Choteau, Okla.--Continued

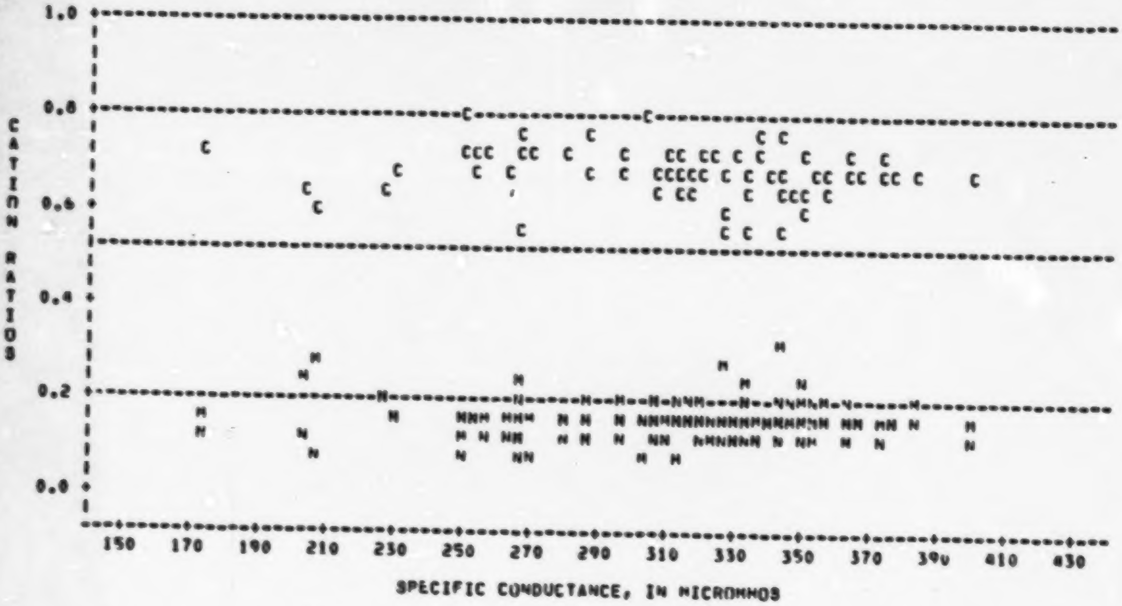
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	147	291	172	400	47	-.28	-.19
Dissolved solids	41	163	134	215	19	.72	.45
pH	137	7.5	3.6	9.0	0.6	-2.11	15.51
Total hardness	139	127	68	180	21	-.22	.41
Chloride	143	13	1.0	105	10	5.87	50.08
Sulfate	65	31	6.0	140	18	3.94	21.13
Iron	0						
Fluoride	15	0.8	0.0	0.6	0.2	1.59	1.93
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	79	0.4	0.2	0.7	0.1	.42	.09
Boron	0						

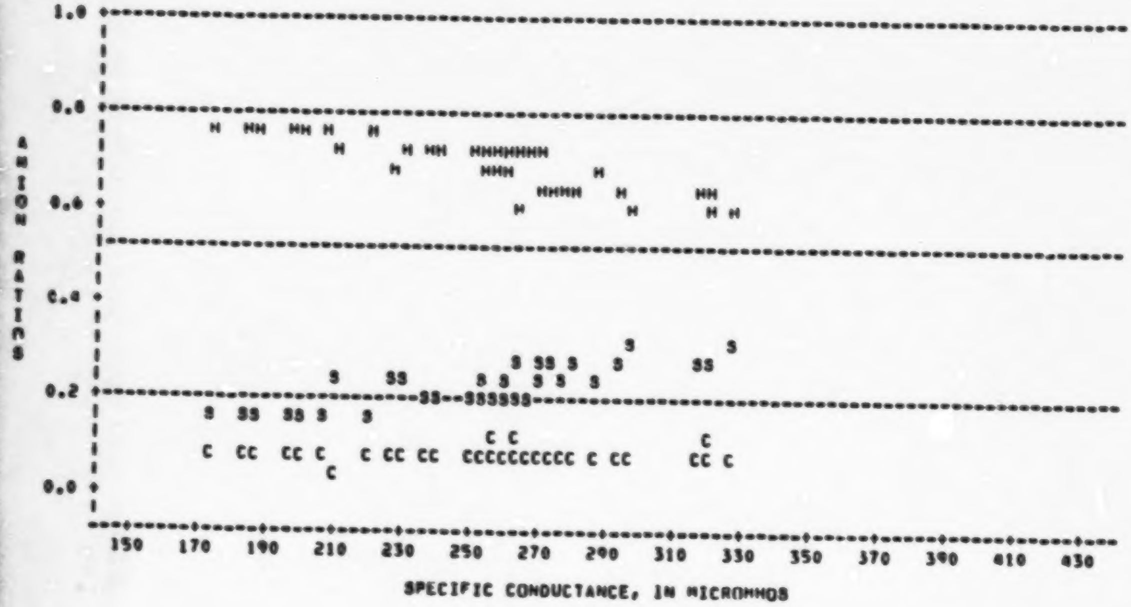
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	226	260	290	324	350
Dissolved solids	136	150	161	170	191
pH	6.9	7.3	7.5	7.8	8.0
Total hardness	97	117	127	140	152
Chloride	6.0	7.5	10	14	22
Sulfate	14	24	28	36	42
Iron					
Fluoride	0.0	0.1	0.1	0.2	0.4
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.2	0.3	0.4	0.4	0.5
Boron					

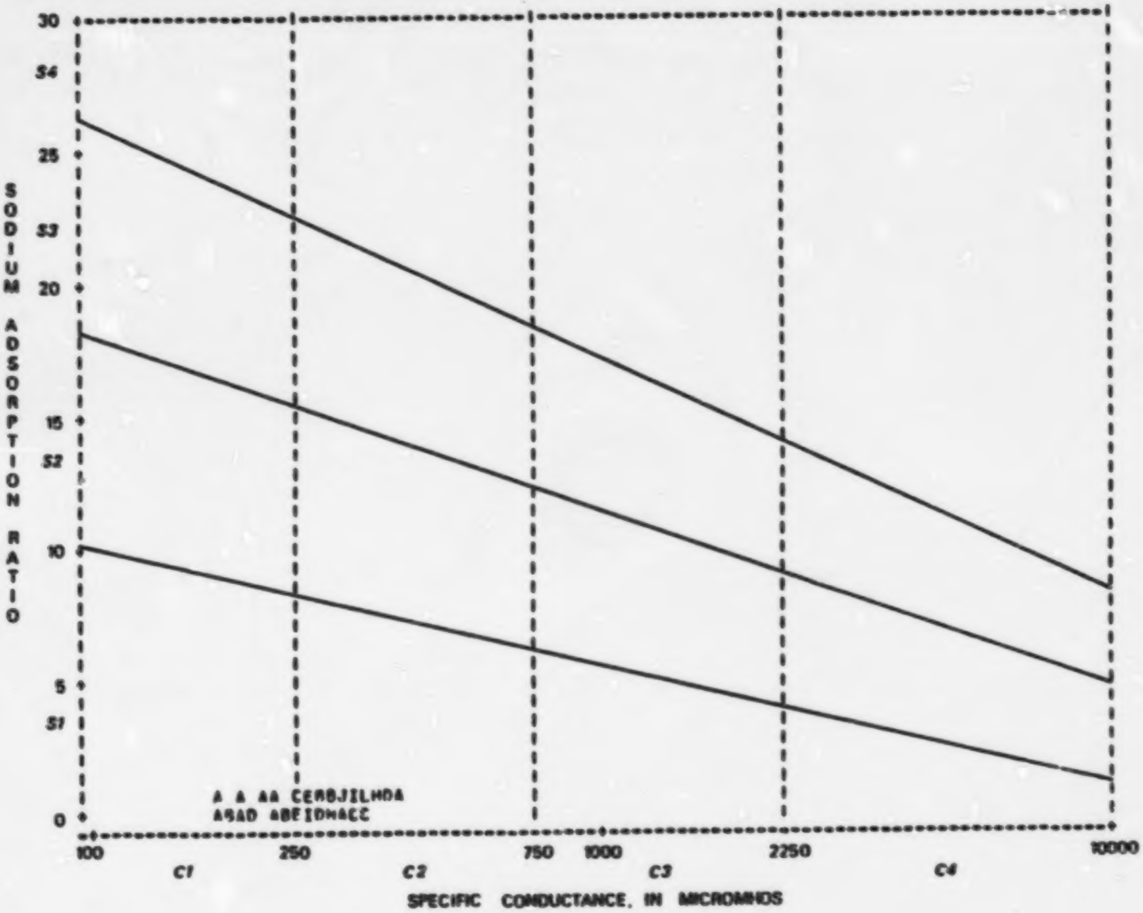
CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=NEOSHO RIVER NR CHOUTEAU, OK



ANION RATIO PLOT
M IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=NEOSHO RIVER NR CHOUTEAU, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=NEOSHO RIVER NR CHOUTEAU, OK



BEST DOCUMENT AVAILABLE

NEOSHO RIVER BASIN

07193500 - Neosho River below Fort Gibson Lake, near Fort Gibson, Okla.

LOCATION.--Lat 35°51'15", long 95°13'45", in SE¼NW¼ sec.19, T.16 N., R.19 E., Cherokee County, 1.1 mi downstream from Fort Gibson Dam, 4.5 mi north of Fort Gibson, and at mile 6.6.

DRAINAGE AREA.--12,495 mi^2.

PERIOD OF RECORD.--1952 to 1978.

WATER TYPE.--The water was calcium carbonate/bicarbonate type throughout the range of specific conductance.

TREND.--Plots of the dissolved solids, hardness, sulfate, and chloride concentrations versus time indicate trends of decreasing concentration. The Spearman's rhos at the 95-percent probability level also indicate decreasing concentration trends.

PUBLIC WATER SUPPLY.--The average hardness was 128 mg/L and the water was hard. Hardness concentrations greater than 120 mg/L occurred for 59 percent of the hardness values. None of the constituents exceeded recommended maximum concentrations limits. The maximum cadmium contaminant level of 10 ug/L was exceeded by 5 percent of the cadmium values, the maximum lead contaminant level of 50 ug/L was exceeded by 3 percent of the lead values, and the maximum mercury contaminant level of 2 ug/L was exceeded by 5 percent of the mercury values. Because the maximum cadmium, lead, and mercury contaminant levels were exceeded, this water may not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to very high with more than 99 percent of the samples in the low or medium salinity hazard classes. The sodium hazard was in the low class for all SAR values. The data indicate that boron phytotoxic effects should not occur.

07193500 - Neosho River below Fort Gibson Lake, near Fort Gibson, Okla.--Continued

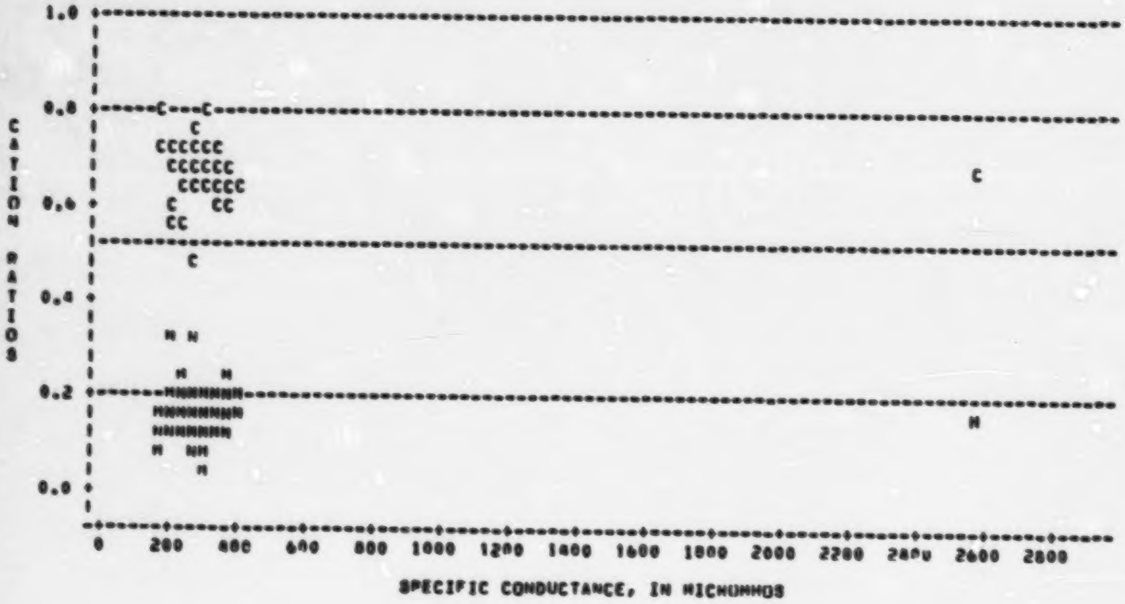
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	486	294	26	2570	124	13.31	238.30
Dissolved solids	348	181	102	272	28	.10	-.26
pH	373	7.8	6.2	8.7	0.4	-.68	1.29
Total hardness	343	128	59	190	20	.13	.06
Chloride	347	12	2.0	23	3.6	.38	-.14
Sulfate	376	39	7.7	65	9.9	.24	-.43
Iron	25	38	0	140	31	1.61	3.50
Fluoride	208	0.2	0.0	1.0	0.1	1.27	4.72
Arsenic	24	1	0	4	1.0	1.63	3.85
Cadmium	21	3	0	34	7.4	4.17	17.99
Chromium	23	2	0	20	5.2	2.47	5.86
Lead	33	15	0	420	73	5.73	32.87
Mercury	22	0.6	0.0	12	2.6	4.68	21.94
SAR	326	0.4	0.1	0.7	0.1	.19	.14
Boron	130	110	0	550	117	1.50	2.08

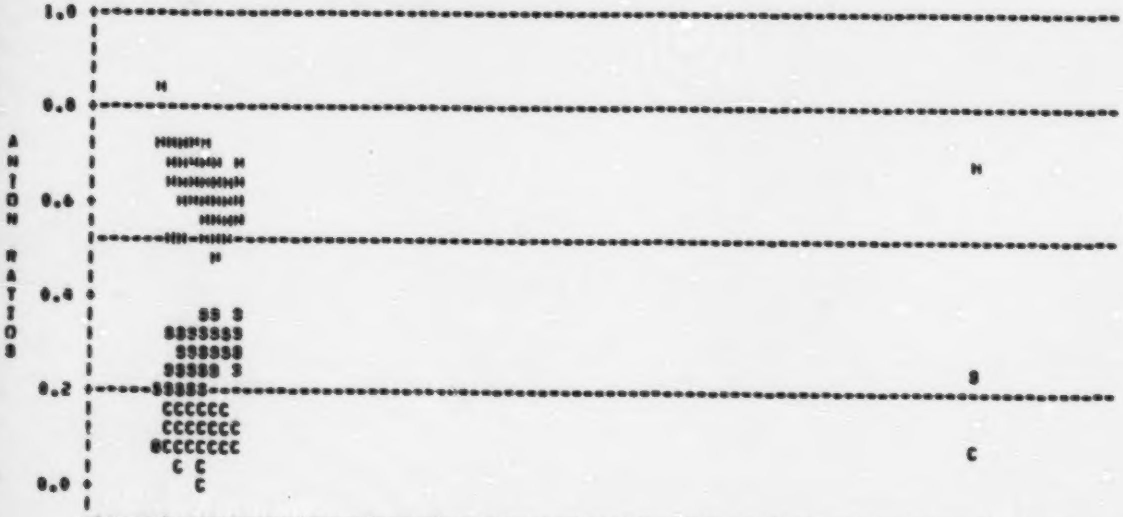
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	231	259	290	320	358
Dissolved solids	145	162	179	201	217
pH	7.3	7.5	7.8	8.0	8.2
Total hardness	100	111	128	140	154
Chloride	7.3	9.0	11	14	16
Sulfate	26	31	38	46	53
Iron	3	11	26	45	75
Fluoride	0.1	0.1	0.2	0.3	0.4
Arsenic	0	0	0	1	2
Cadmium	0	0	0	1	2
Chromium	0	0	0	0	6
Lead	0	0	1	3	9
Mercury	0.0	0.0	0.0	0.0	0.1
SAR	0.3	0.3	0.4	0.4	0.5
Boron	0	9	65	155	260

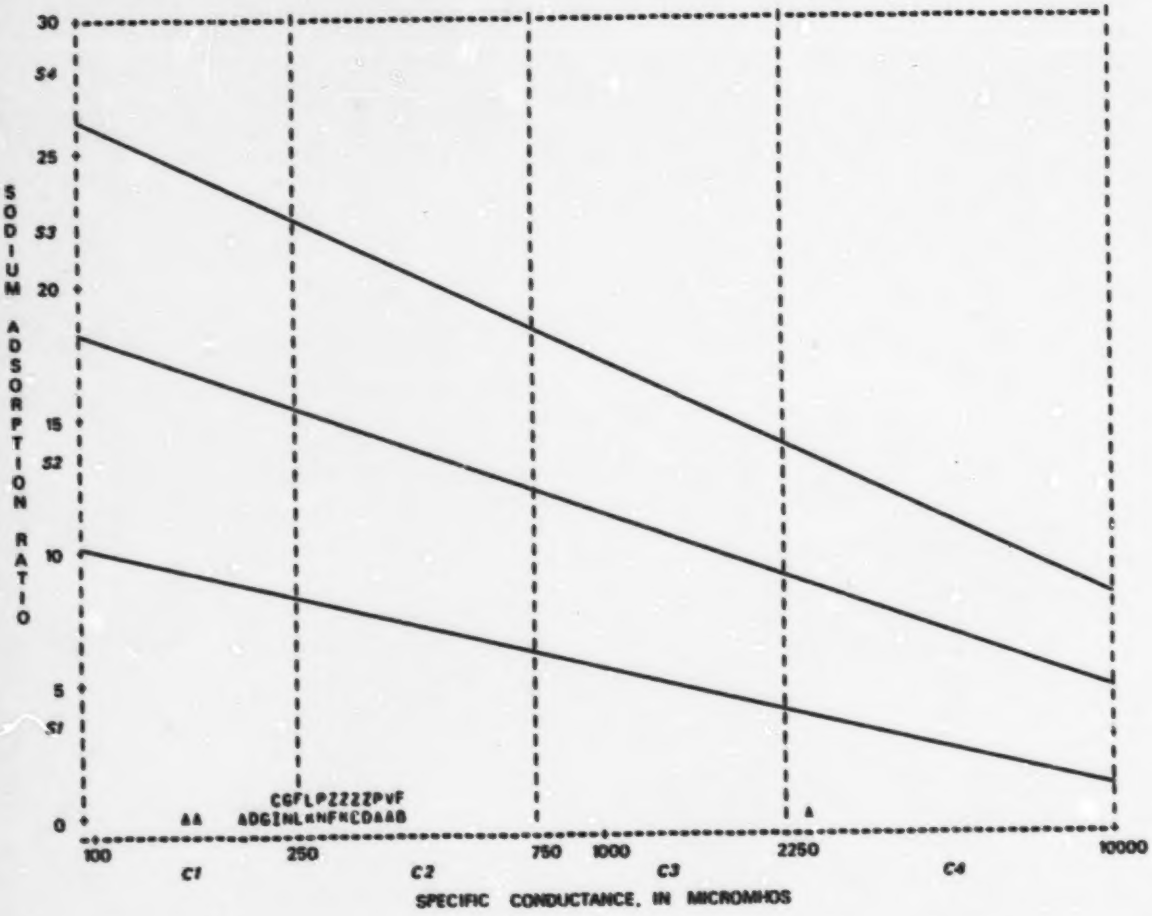
CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=NEOSHO RIVER BLW FT GIBSON LAKE NR FT GIBSON, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIU, C IS CHLORIDE ION RATIU, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=NEOSHO RIVER BLW FT GIBSON LAKE NR FT GIBSON, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=NEOSHO RIVER BLW FT GIBSON LAKE NR FT GIBSON, OK



BEST DOCUMENT AVAILABLE

07192000 - Pryor Creek near Pryor, Okla.

LOCATION.--Lat 36°16'52", long 95°19'32", in SE¼SE¼ sec.24, T.21 N., R.18 E., Mayes County, at bridge on U.S. Highway 69, 1.7 mi south of Pryor, and at mile 10.5.

DRAINAGE AREA.--229 mi^2.

PERIOD OF RECORD.--1948 to 1963.

WATER TYPE.--The water was sodium type throughout the range of specific conductance. No predominant anion occurred for specific conductance less than about 1,000 umhos. There were no anion data for specific conductances greater than 1,000 umhos.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 126 mg/L; however, the water was moderately hard. Hardness concentrations were equal to or less than 120 mg/L for 69 percent of the hardness values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 6 percent of the chloride values and the recommended minimum pH of 5.0 was exceeded by 4 percent of the pH values. No toxic element data were available. Because of the occurrence of very high chloride concentrations and low pH values, this water may not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to very high with 83 percent of the samples having a low or medium salinity hazard. The sodium hazard ranged from low to very high with 92 percent of the SAR values having a low sodium hazard. No boron data were available.

07192000 - Pryor Creek near Pryor, Okla.--Continued

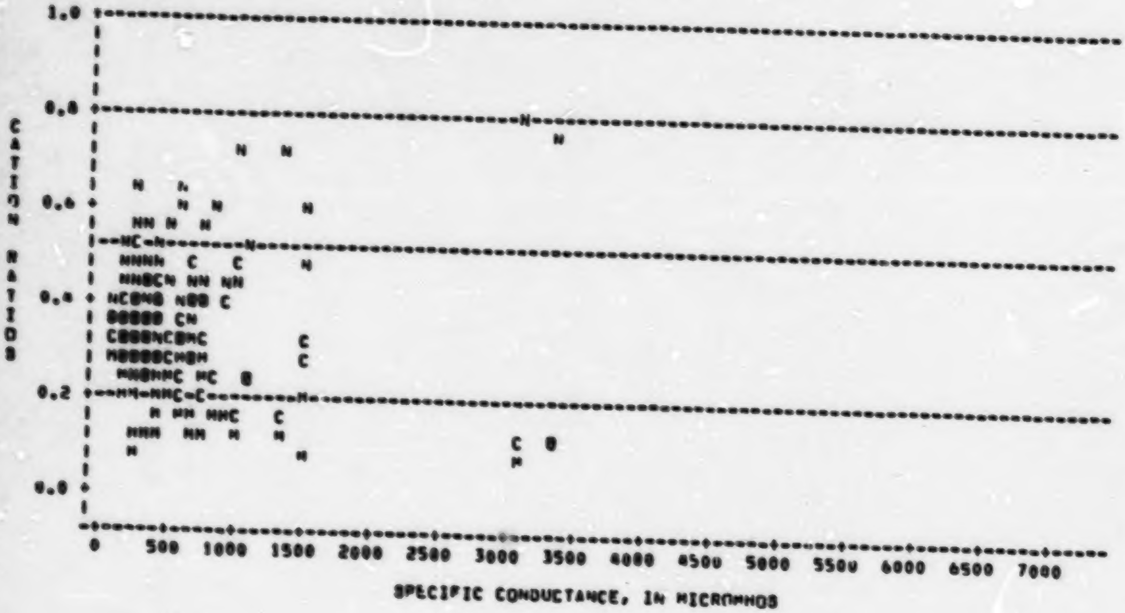
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	98	634	77	6780	963	4.34	21.17
Dissolved solids	19	212	54	529	101	1.65	4.88
pH	72	7.0	3.0	8.5	0.9	-2.47	8.30
Total hardness	83	126	20	670	101	2.97	11.57
Chloride	83	138	3.5	2160	334	4.33	20.16
Sulfate	32	56	22	87	19	-.11	-.97
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	66	2.8	0.6	50	6.3	6.73	49.59
Boron	0						

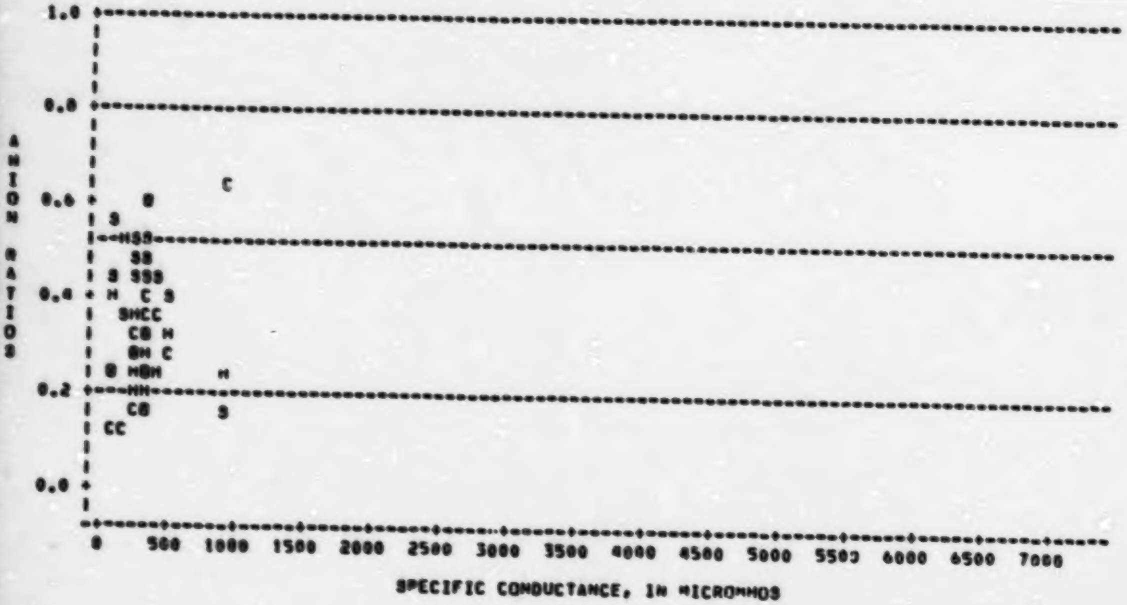
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	183	252	358	582	971
Dissolved solids	93	162	192	237	298
pH	6.1	6.7	7.0	7.4	7.8
Total hardness	47	71	98	147	218
Chloride	9.9	21	40	87	187
Sulfate	29	38	59	69	82
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.8	1.0	1.4	2.2	3.6
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=PRYOR CREEK NR PRYOR, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=PRYOR CREEK NR PRYOR, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=PRYOR CREEK NR PRYOR, OK
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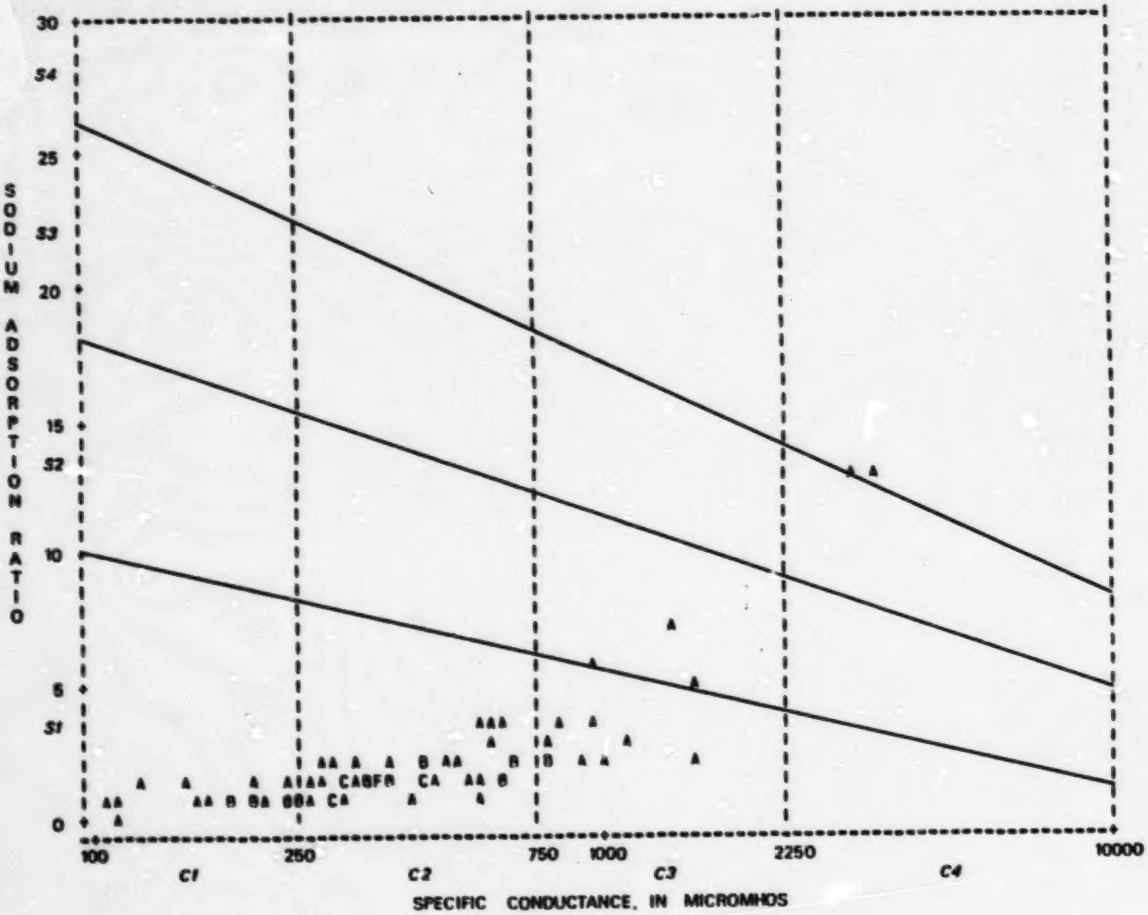


BEST DOCUMENT AVAILABLE

07192030 - Pryor Creek at Elliot Street Bridge, near Pryor, Okla.

LOCATION.--Lat 36°16'00", long 95°18'30", in SW¼SW¼ sec.21, T.21 N., R.19 E., Mayes County, at Elliot Street Bridge, 1.3 mi south of Pryor.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1966 to 1971.

WATER TYPE.--The data indicate that the water was sodium type. The anion data indicate that there was no predominant anion.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 88 mg/L and the water was moderately hard. Hardness concentrations 120 mg/L or less occurred for 82 percent of the hardness values. The recommended maximum chloride concentration of 250 mg/L was exceeded by less than 1 percent of the chloride values. No toxic metal data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to very high with 97 percent of the samples in the low or medium salinity hazard classes. The sodium hazard was in the low class for all of the SAR values. The data indicate that boron phytotoxic effects should not occur.

07192030 - Pryor Creek at Elliot Street Bridge, near Pryor, Okla.--Continued

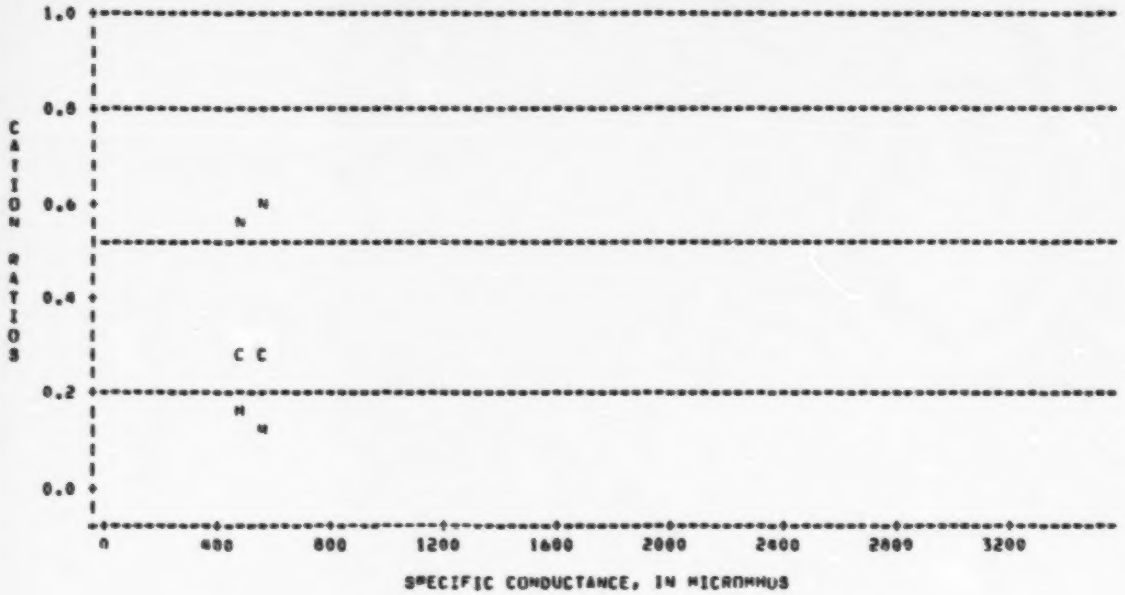
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	249	389	69	3180	251	5.87	61.42
Dissolved solids	148	223	64	520	91	.83	.41
pH	170	7.2	6.2	8.8	0.4	.78	.82
Total hardness	55	88	40	150	28	.40	-.74
Chloride	250	34	1.0	360	37	4.43	28.88
Sulfate	170	57	12	129	20	.26	.11
Iron	0						
Fluoride	2	0.4	0.3	0.4			
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	2	2.8	2.6	3.0			
Boron	3	325	310	340			

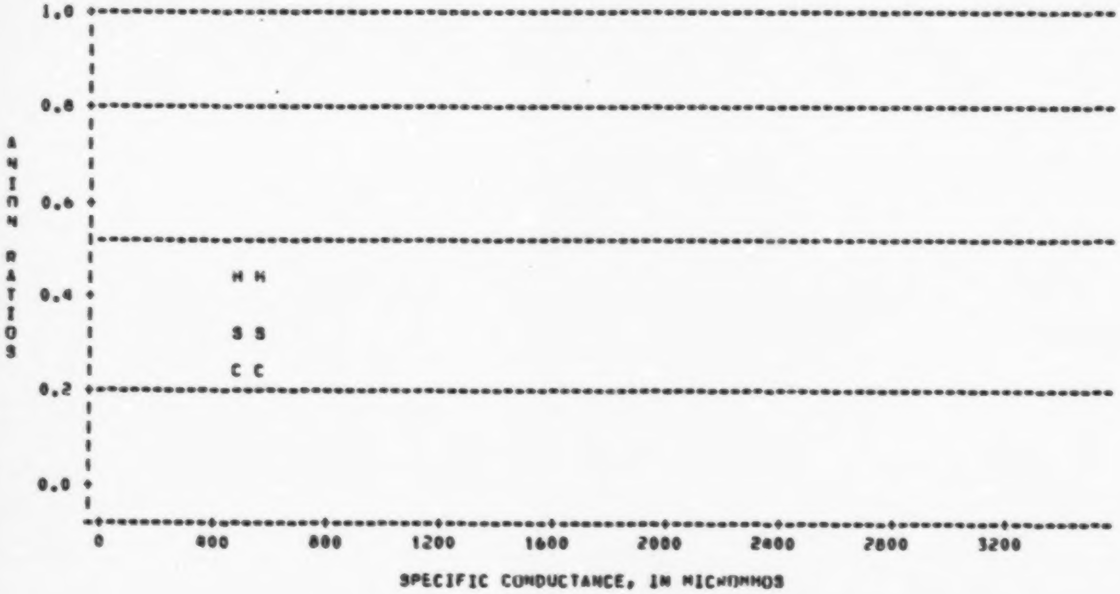
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	185	249	337	486	625
Dissolved solids	120	160	204	278	360
pH	6.6	6.8	7.2	7.4	7.7
Total hardness	51	62	83	106	129
Chloride	8.0	15	25	42	60
Sulfate	29	42	57	70	83
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR					
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=PRYOR CREEK AT ELLIOT ST BR NR PRYOR, OK

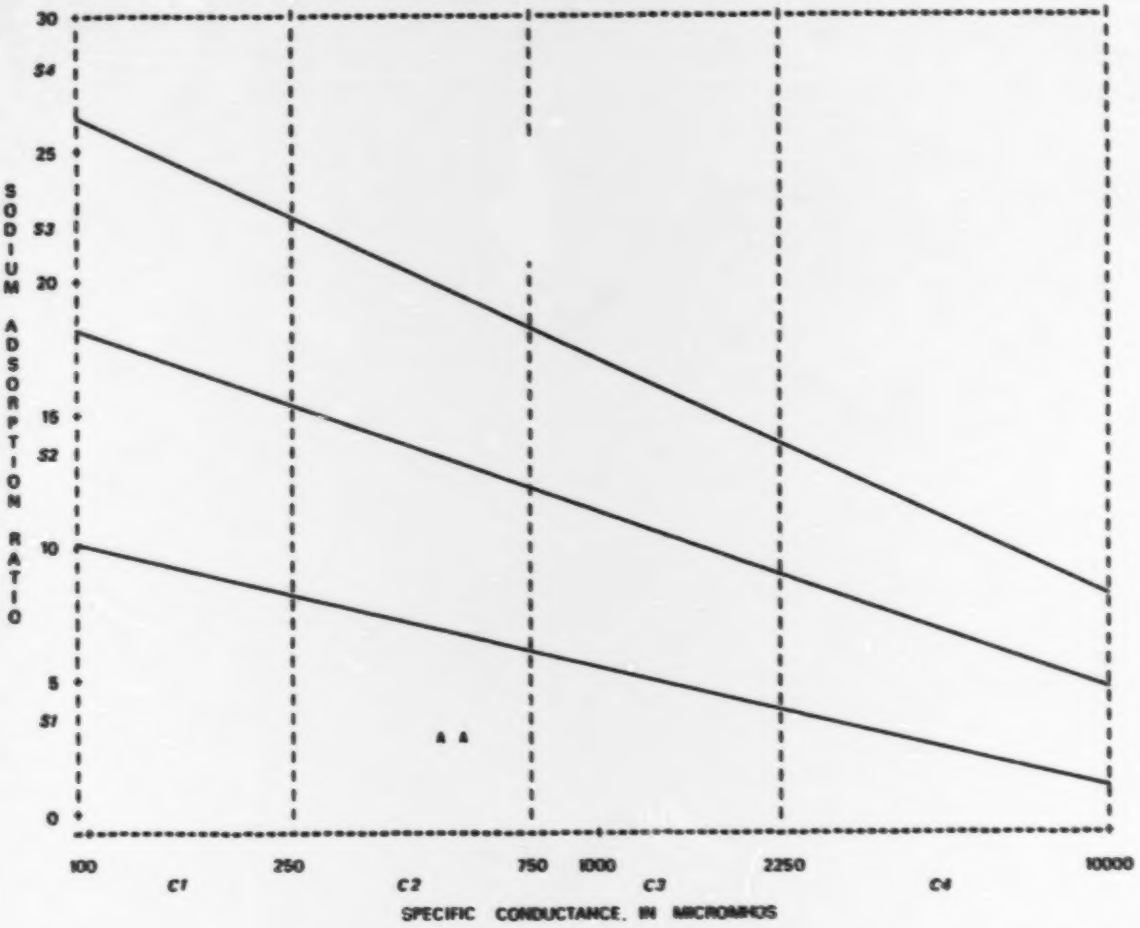


ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=PRYOR CREEK AT ELLIOT ST BR NR PRYOR, OK



BEST DOCUMENT AVAILABLE

IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD, C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=PRYOR CREEK AT ELLIOT ST BR NR PRYOR, OK



NEOSHO RIVER BASIN

07192060 - Pryor Creek below Sulfur Creek, near Pryor, Okla.

LOCATION.--Lat 36°13'29", long 95°15'20", NW¼NE¼ sec.10, T.20 N., R.19 E., Mayes County, at abandoned bridge, approximately 2 mi downstream from Sulfur Creek, and 5.4 mi southeast of Pryor.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1966 to 1975.

WATER TYPE.--The water was mixed type. The data indicate that for specific conductance greater than 1,000 umhos, the chloride ion may predominate.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 121 mg/L; however, the water was moderately hard. Hardness concentrations were equal to or less than 120 mg/L for 64 percent of the hardness values. The recommended minimum pH limit of 5.0 was exceeded by 2 percent of the pH values and the recommended maximum limit of 9.0 was also exceeded by 2 percent of the pH values. The recommended maximum chloride concentration of 250 mg/L was exceeded by 2 percent of the chloride values. No toxic metal data were available. Because of the wide variations in pH and because the recommended maximum chloride concentration was exceeded, this water may not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to very high with 81 percent of the samples having a low or medium salinity hazard. The sodium hazard was in the low class for all SAR values. No boron data were available.

07192060 - Pryor Creek below Sulfur Creek, near Pryor, Okla.--Continued

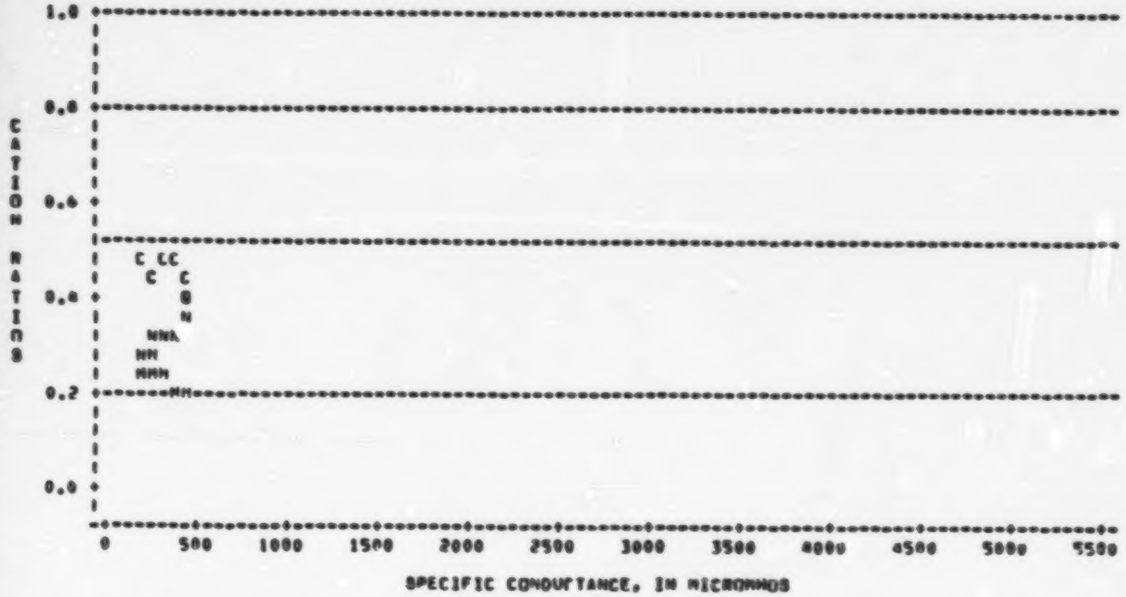
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	457	512	80	4930	378	4.68	43.65
Dissolved solids	175	287	59	734	139	.66	-.41
pH	262	7.1	4.3	9.6	0.7	-.25	3.50
Total hardness	59	121	42	262	54	.95	.13
Chloride	443	51	1.0	565	63	3.78	19.81
Sulfate	192	91	15	228	50	.76	-.35
Iron	0						
Fluoride	0						
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	9	1.0	0.6	1.5			
Boron	0						

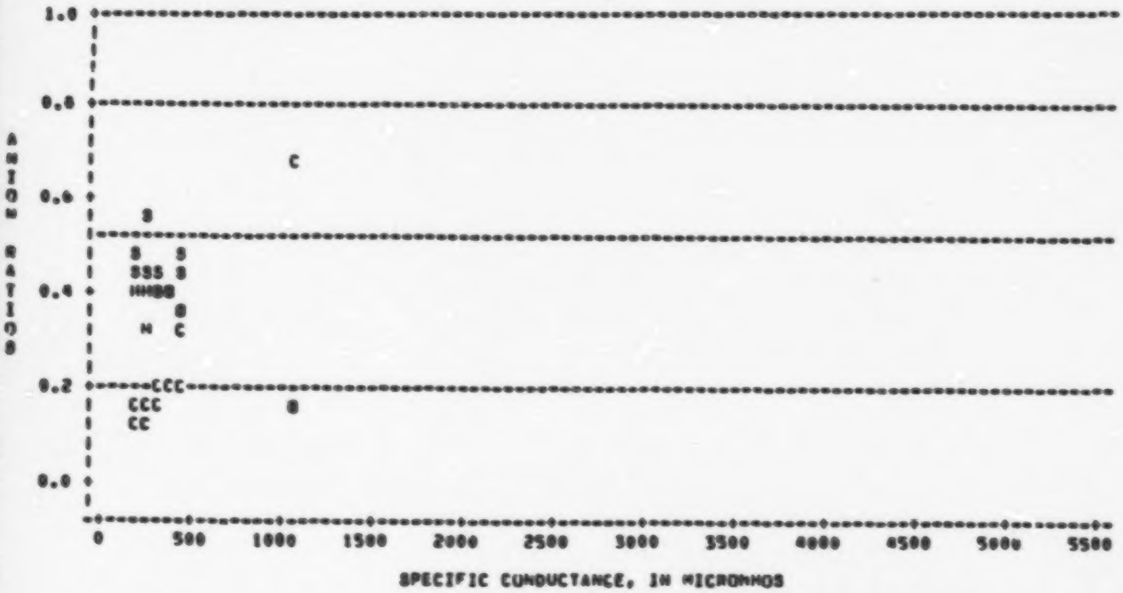
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	195	272	423	673	852
Dissolved solids	136	181	242	407	491
pH	6.5	6.7	7.1	7.5	7.8
Total hardness	63	84	106	143	204
Chloride	8.0	14	32	65	94
Sulfate	37	54	75	123	166
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR					
Boron					

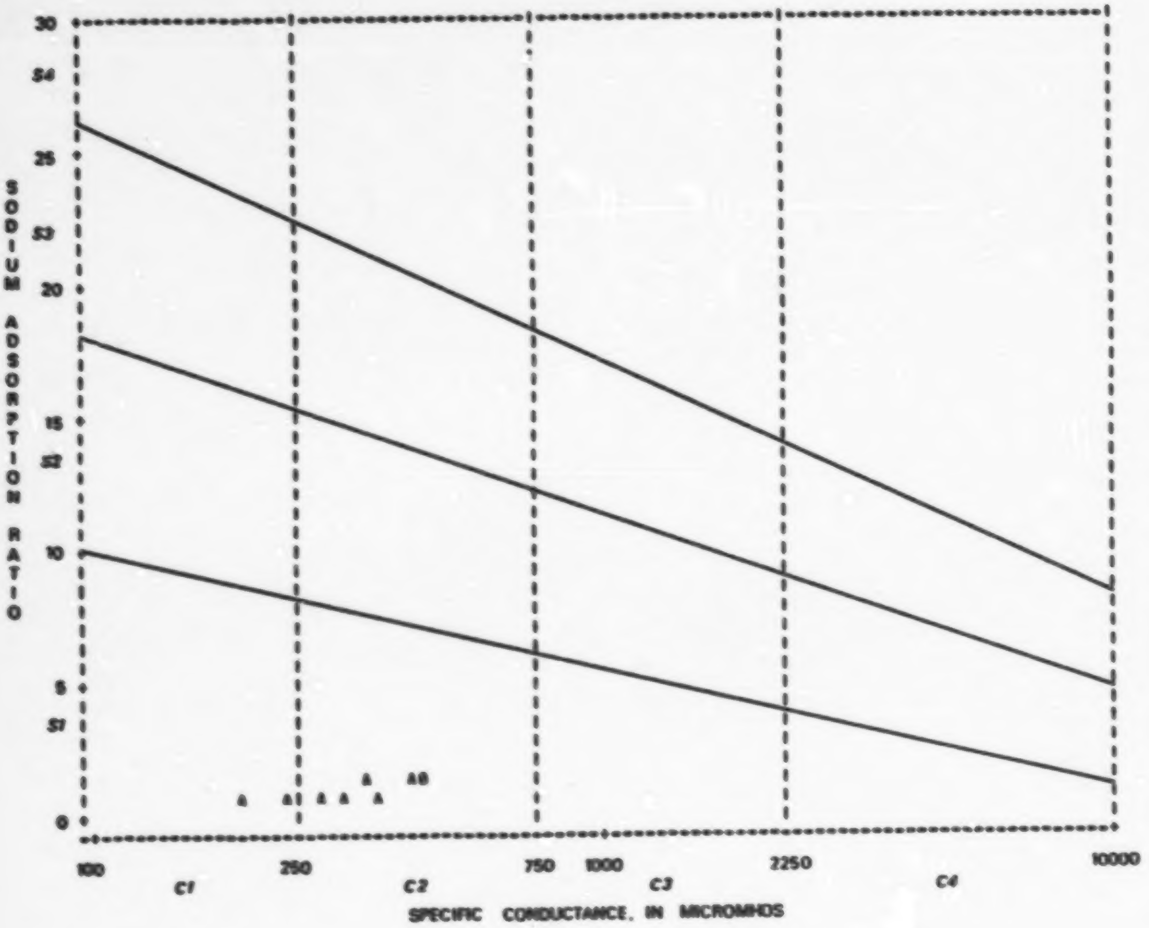
CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=PRYOR CREEK BLW SULFUR CREEK NR PRYOR, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=PRYOR CREEK BLW SULFUR CREEK NR PRYOR, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD, C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD, C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=PRYOR CREEK BLW SULFUR CREEK NW PRYOR, OK



BEST DOCUMENT AVAILABLE

NEOSHO RIVER BASIN

07191200 - Spavinaw Creek near Row, Okla.

LOCATION.--Lat 36°19'50", long 94°32'30", in NW¼ sec.3, T.21 N., R.25 E., Delware County, at bridge on county road, 2.2 mi upstream from Cherokee Creek, and 5 mi northeast of Row.

DRAINAGE AREA.--Not determined.

PERIOD OF RECORD.--1959 to 1961.

WATER TYPE.--The water was calcium carbonate/bicarbonate type throughout the range of measured specific conductance.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 109 mg/L and the water was moderately hard. Hardness concentrations were less than 120 mg/L for 90 percent of the hardness values. None of the constituents exceeded their recommended maximum concentrations. No toxic metal data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with 97 percent of the samples in the low salinity hazard class, specific conductance less than 250 umhos. The salinity hazard was in the low class for all SAR values. The data indicate that boron phytotoxic effects should not occur.

07191200 - Spavinaw Creek near Row, Okla.--Continued

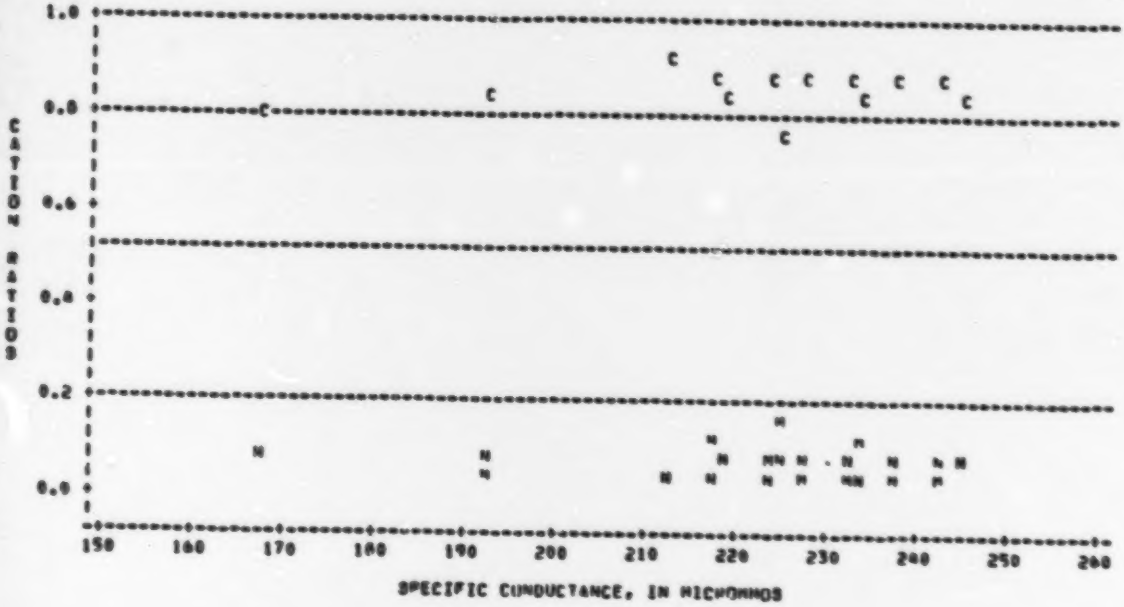
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	33	225	168	259	17	-1.27	2.96
Dissolved solids	8	130	102	144			
pH	33	7.9	7.2	8.4	9.7	-.50	.33
Total hardness	32	109	81	134	9.7	-.43	2.25
Chloride	29	7.7	3.0	13	2.2	.24	.01
Sulfate	8	4.9	2.5	9.5			
Iron	0						
Fluoride	13	0.0	0.0	0.0	0.0	--	--
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	15	0.2	0.1	0.2	0.1	-1.18	-.73
Boron	5	42	0	110			

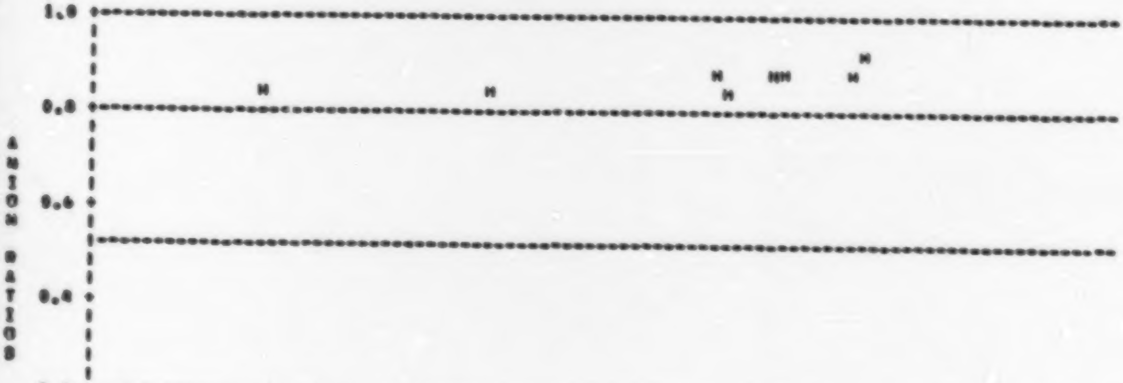
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	196	217	227	234	239
Dissolved solids					
pH	7.5	7.7	7.9	8.1	8.2
Total hardness	94	104	110	112	118
Chloride	5.1	5.9	7.2	9.2	10
Sulfate					
Iron					
Fluoride	0.0	0.0	0.0	0.0	0.0
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.0	0.1	0.1	0.2	0.2
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=SPAVINAW CREEK NR ROW, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=SPAVINAW CREEK NR ROW, OK



BEST DOCUMENT AVAILABLE

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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=SPAVINAW CREEK NR ROW, OK
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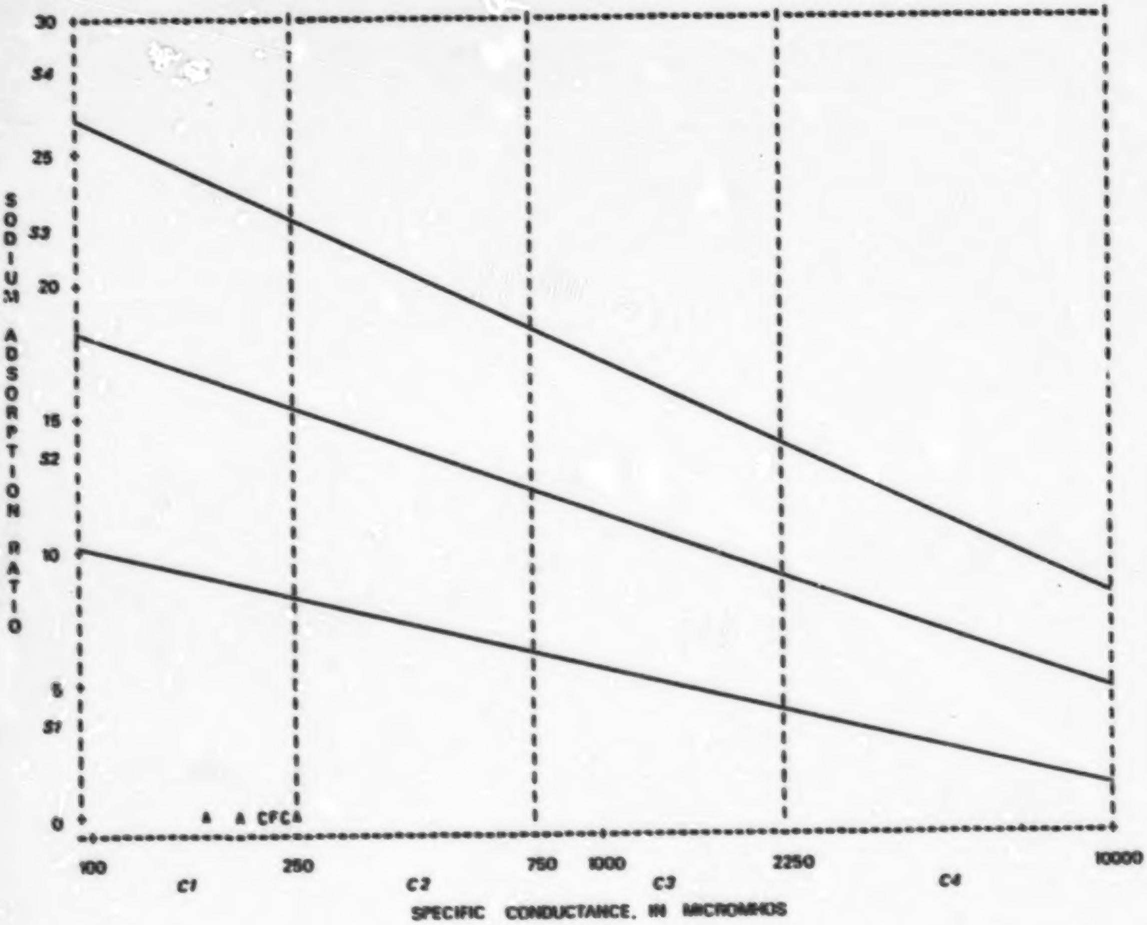


BEST DOCUMENT AVAILABLE

07188000 - Spring River near Quapaw, Okla.

LOCATION.--Lat 36°56'04", long 94°44'45", in NE¼SW¼ sec.5, T.28 N., R.24 E., Ottawa County, at county road bridge, 0.1 mi upstream from Rock Creek, 3.0 mi southeast of Quapaw, and at mile 13.9.

DRAINAGE AREA.--3,510 mi^2, includes that of Rock Creek.

PERIOD OF RECORD.--1948 to 1958, 1960 to 1963, 1976 to 1978.

WATER TYPE.--The water varied between calcium carbonate/bicarbonate and calcium sulfate type. The variation of water type for specific conductance less than or equal to 440 umhos, which occurred in 74 percent of the samples, did not appear to be specific conductance related and the water was equally likely to be calcium carbonate/bicarbonate type or calcium sulfate type. For specific conductance greater than 440 umhos, the water was calcium sulfate type.

TREND.--The current period of record is insufficient, less than 5 years, to perform analysis for trend.

PUBLIC WATER SUPPLY.--The average hardness was 175 mg/L; however, the water was very hard. Hardness concentrations greater than 180 mg/L, very hard class, occurred for 48 percent of the hardness values. None of the constituents exceeded their recommended maximum concentration. The maximum contaminant level for fluoride was exceeded by 7 percent of the fluoride values. No toxic metal data were available. Because the maximum fluoride contaminant level was exceeded, this water may not be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with 91 percent of the samples having a medium salinity hazard. The sodium hazard was in the low class for all SAR values. No boron data were available.

07188000 - Spring River near Quapaw, Okla.--Continued

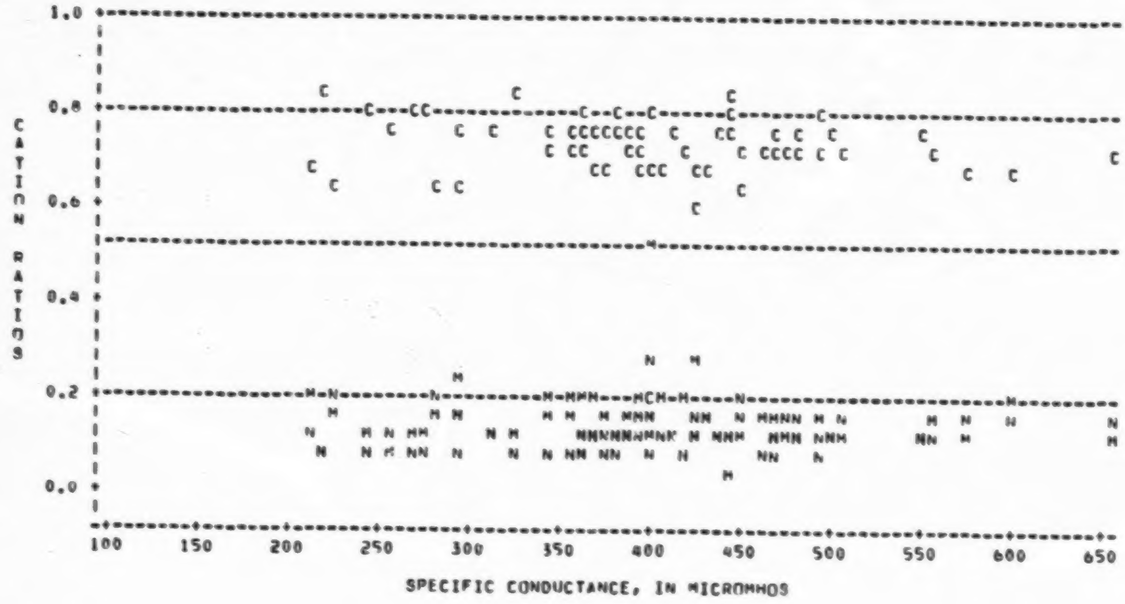
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	218	376	137	654	91	-.05	.02
Dissolved solids	117	249	93	383	68	.04	-.84
pH	134	7.6	6.6	8.9	0.4	.17	-.10
Total hardness	199	175	9.3	286	50	-.42	-.01
Chloride	205	9.8	1.0	45	6.2	2.10	6.66
Sulfate	147	80	1.0	188	33	.46	-.21
Iron	0						
Fluoride	29	0.7	0.0	3.0	0.8	1.67	2.31
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	67	0.3	0.1	0.7	0.1	.72	.05
Boron	0						

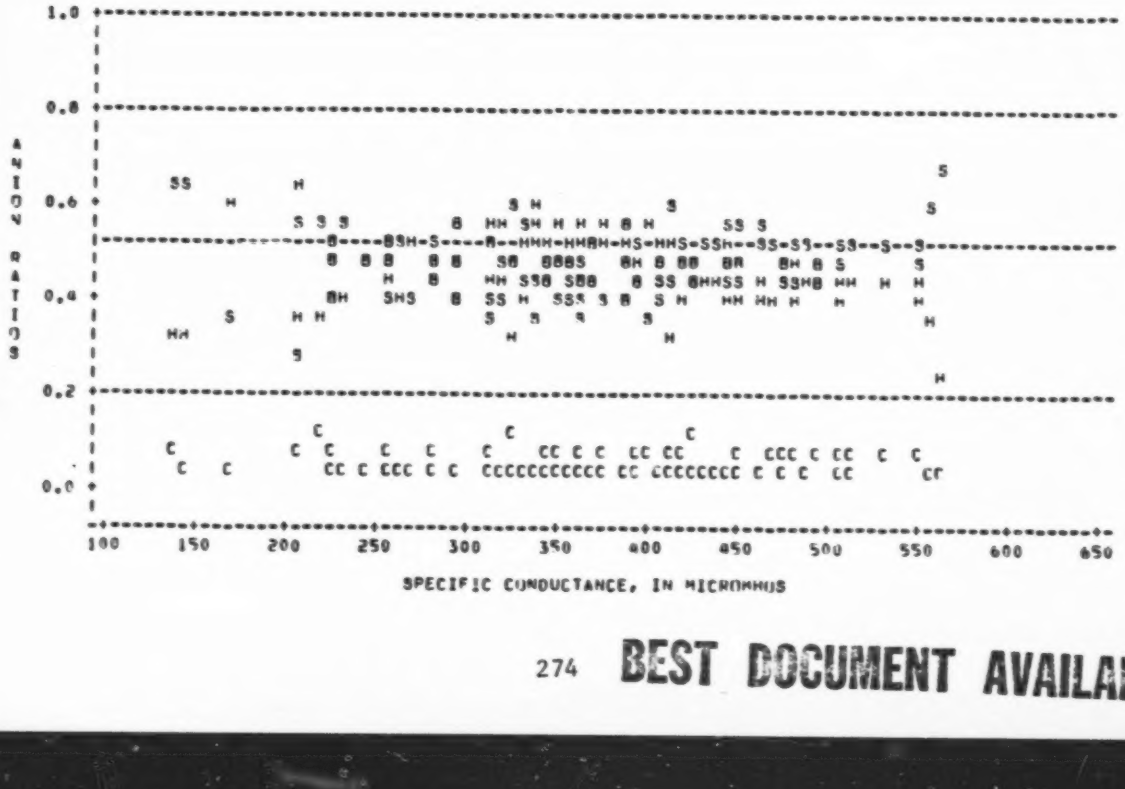
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	255	323	370	444	487
Dissolved solids	156	201	238	310	336
pH	7.0	7.3	7.6	7.8	8.1
Total hardness	101	150	180	210	236
Chloride	4.2	5.8	8.8	11	18
Sulfate	40	56	74	106	128
Iron					
Fluoride	0.0	0.1	0.3	0.8	1.8
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.1	0.2	0.3	0.4	0.5
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=SPRING RIVER NR QUAPAW, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=SPRING RIVER NR QUAPAW, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,   B = 2 OBS,   C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=SPRING RIVER NR QUAPAW, OK
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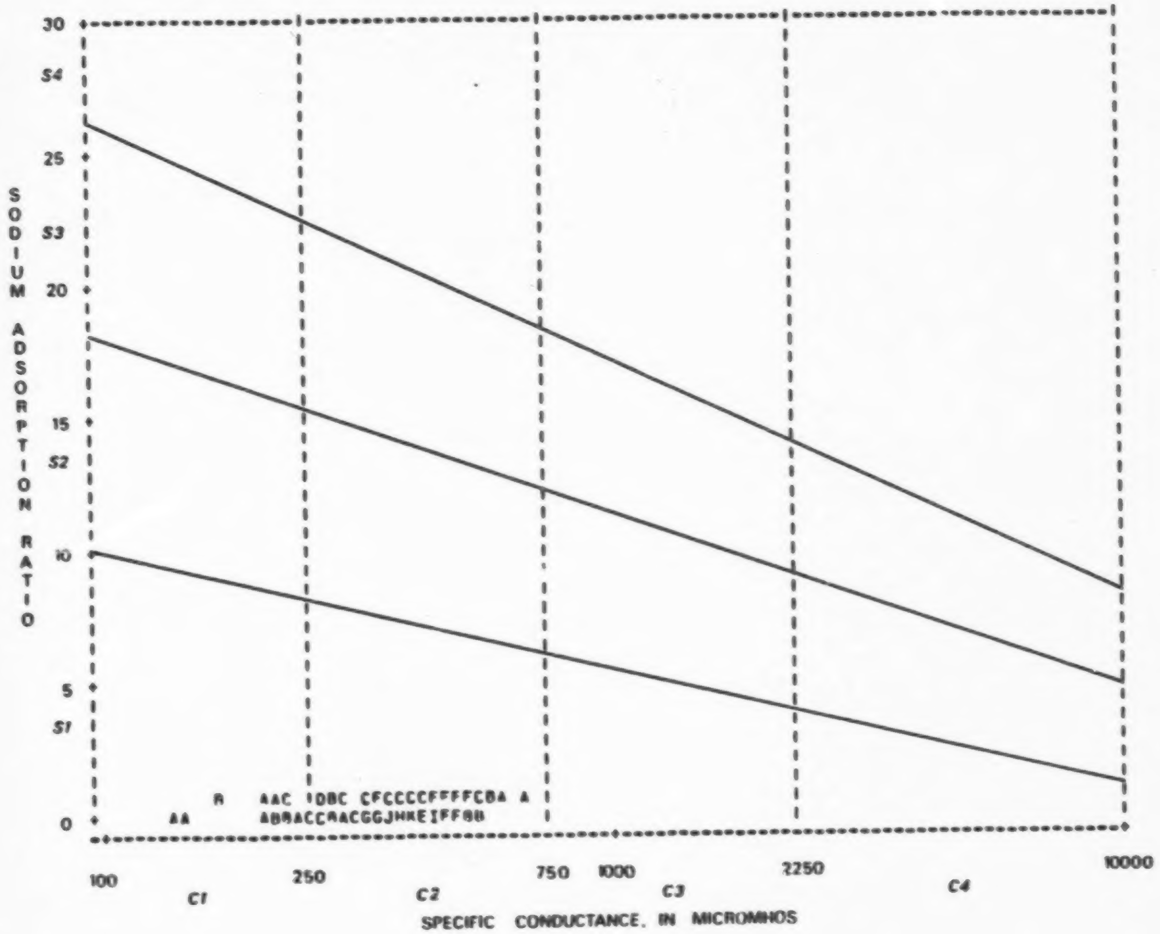


07196900 - Baron Fork at Dutch Mills, Ark.

LOCATION.--Lat 35°52'48", long 94°29'11", on line between secs.21 and 22, T.14 N., R.33 W., Washington County, at bridge on State Highway 59 at Dutch Mills, 2.2 mi downstream from Fly Creek, and 2.9 mi upstream from Arkansas-Oklahoma State line.

DRAINAGE AREA.--46.0 mi^2.

PERIOD OF RECORD.--1960 to 1961.

WATER TYPE.--The water was calcium carbonate/bicarbonate type throughout the range of measured specific conductance.

TREND.--No current data were available.

PUBLIC WATER SUPPLY.--The average hardness was 127 mg/L and the water was hard. Hardness concentrations were greater than 120 mg/L for 64 percent of the hardness values. None of the constituents exceeded their recommended maximum concentration. No toxic metal data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with 52 percent of the samples having a medium salinity hazard. The sodium hazard was in the low class for all SAR values. No boron data were available.

07196900 - Baron Fork at Dutch Mills, Ark.--Continued

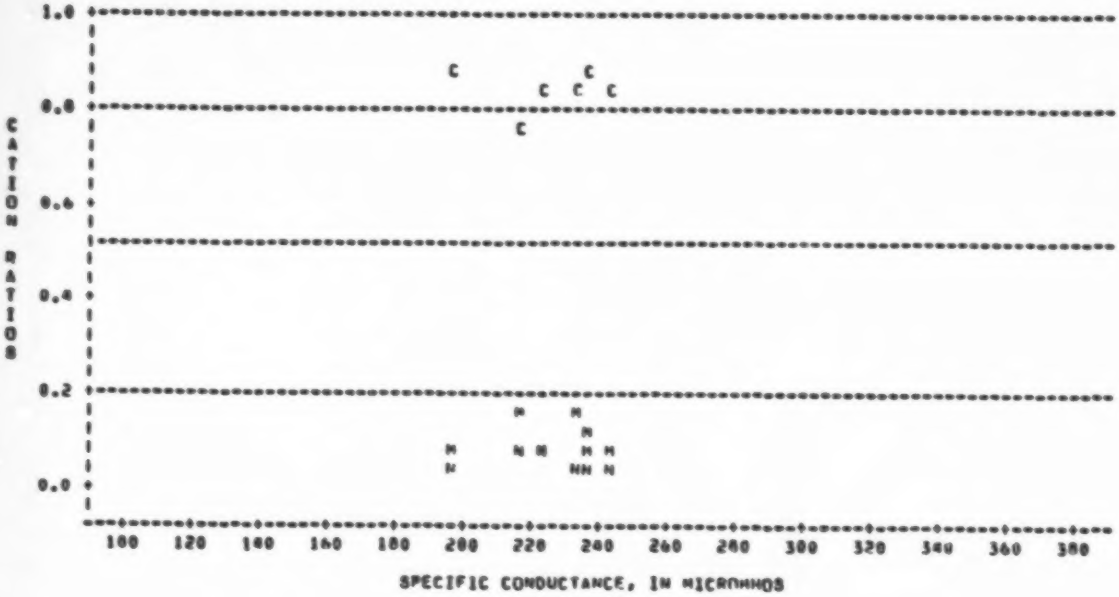
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	101	255	117	365	46	-.26	1.04
Dissolved solids	22	156	124	219	28	1.01	.25
pH	98	7.9	7.3	8.6	0.3	.36	.07
Total hardness	36	127	86	180	23	.06	-.09
Chloride	88	6.8	3.0	12	2.0	.17	-.19
Sulfate	52	11	1.0	29	5.7	1.07	1.59
Iron	0						
Fluoride	4	0.0	0.0	0.1			
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	8	0.1	0.0	0.2			
Boron	0						

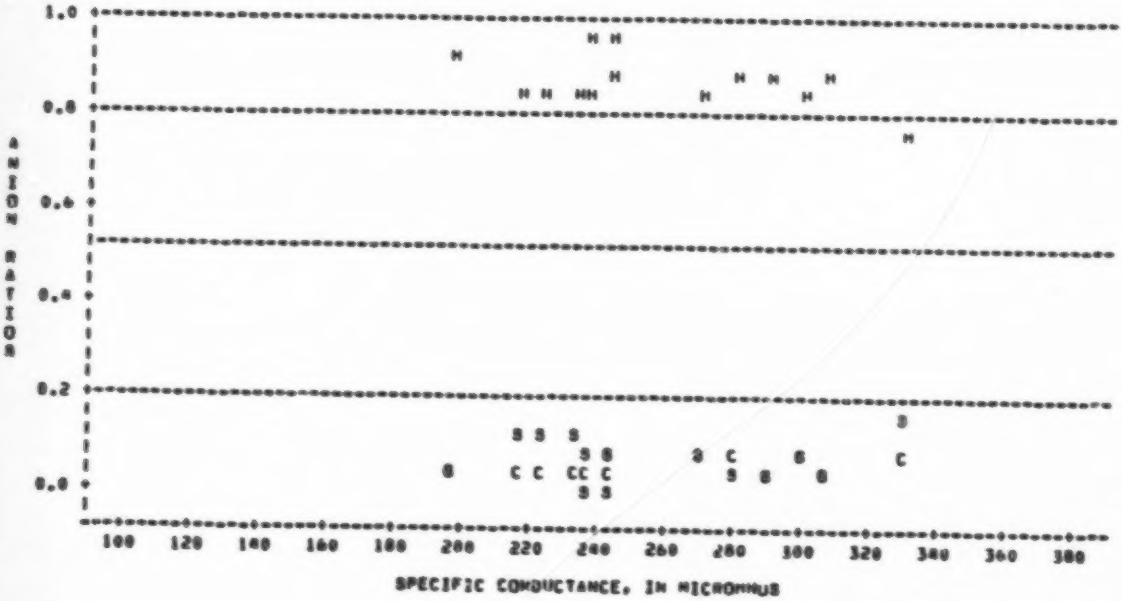
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	201	225	256	282	300
Dissolved solids	126	134	147	168	193
pH	7.5	7.7	7.9	8.0	8.2
Total hardness	91	112	128	140	151
Chloride	3.9	5.2	6.8	7.9	9.4
Sulfate	4.0	7.1	9.6	13	17
Iron					
Fluoride					
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR					
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BARON FK AT DUTCH MILLS ARK.



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BARON FK AT DUTCH MILLS ARK.



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=BARON FK AT DUTCH MILLS ARK.
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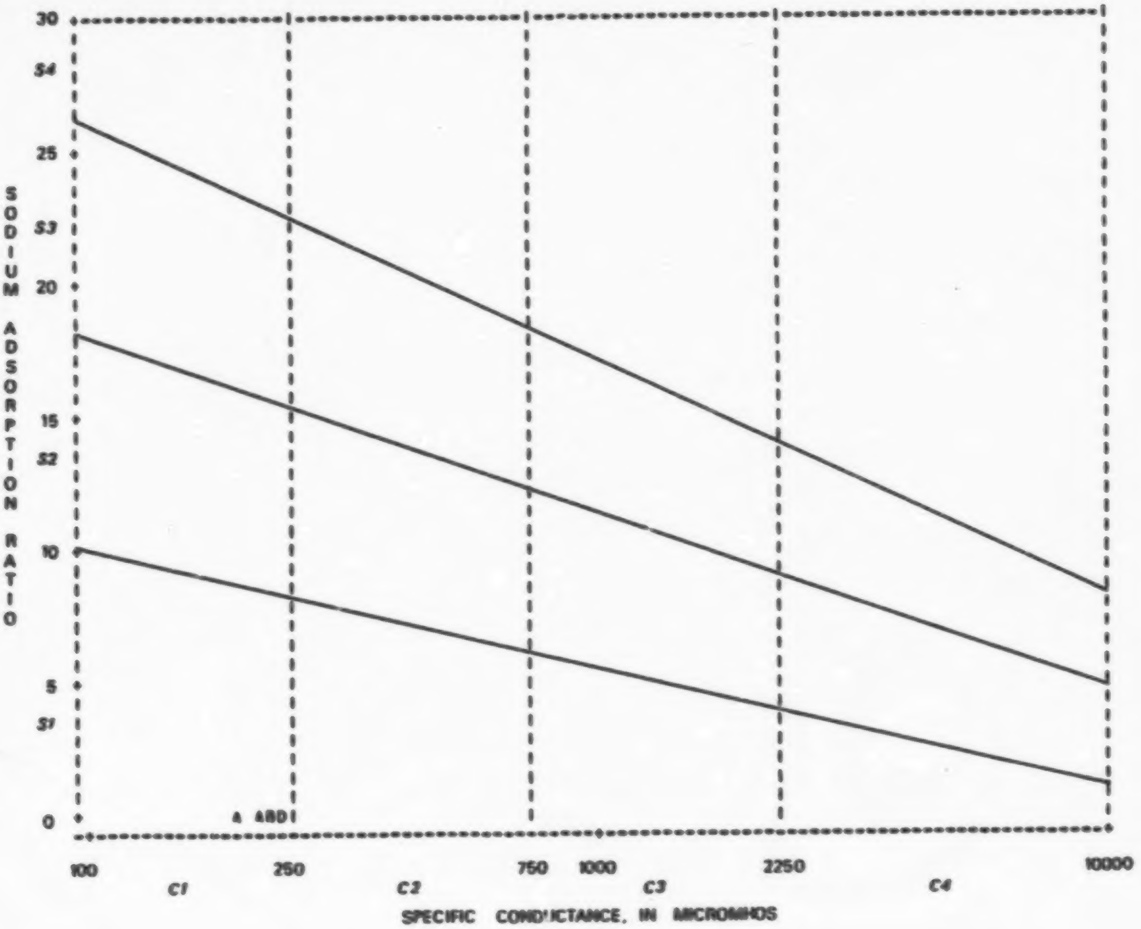


ILLINOIS RIVER BASIN

07197000 - Baron Fork at Eldon, Okla.

LOCATION.--Lat 35°55'16", long 94°50'18", in SE¼ sec.27, T.17 N., R.23 E., Cherokee County, at bridge on State Highway 51, 0.4 mi southeast of Eldon, 6.0 mi downstream from Tyner Creek, and at mile 8.8.

DRAINAGE AREA.--307 mi^2.

PERIOD OF RECORD.--1958 to 1960, 1976 to 1978.

WATER TYPE.--The water was calcium carbonate/bicarbonate type throughout the range of measured specific conductance.

TREND.--The current period of record is insufficient, less than 5 years, to perform analysis for trend.

PUBLIC WATER SUPPLY.--The average hardness was 82 mg/L and the water was moderately hard. Hardness concentrations less than 120 mg/L occurred for 98 percent of the hardness values. None of the constituents exceeded their recommended maximum concentration. No toxic metal data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard was low class for all samples. The sodium hazard was in the low class for all SAR values. The data indicate that boron phytotoxic effects should not occur.

07197000 - Baron Fork at Eldon, Okla.--Continued

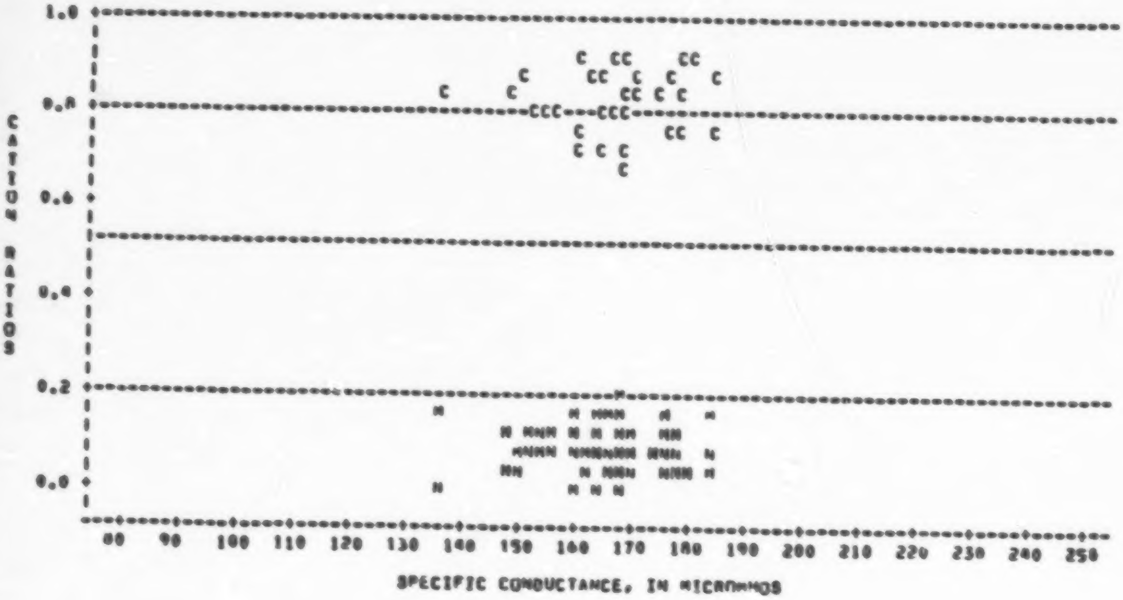
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	93	175	94	240	22	.24	2.18
Dissolved solids	12	105	92	124	10	.54	-.46
pH	93	7.6	6.3	8.3	0.4	-.59	-.30
Total hardness	81	82	48	126	11	1.60	6.94
Chloride	80	5.1	1.0	24	3.8	2.42	7.81
Sulfate	47	8.4	1.0	33	8.4	1.79	2.34
Iron	0						
Fluoride	18	0.1	0.0	1.0	0.2	2.83	8.62
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	33	0.2	0.0	0.3	0.1	-.44	-.22
Boron	10	40	0	110	38	.53	-.70

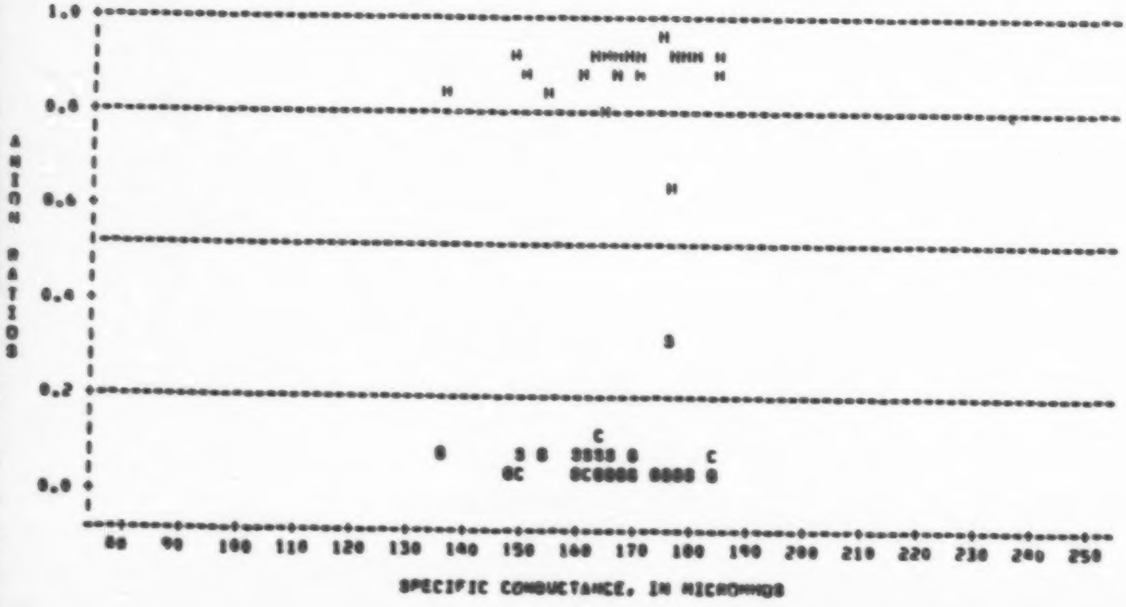
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION 10th	25th	50th	75th	90th
Specific conductance	152	163	171	180	201
Dissolved solids	92	97	103	110	119
pH	6.8	7.2	7.6	7.8	8.0
Total hardness	73	76	81	84	90
Chloride	1.9	2.7	4.0	6.0	10
Sulfate	1.9	3.2	5.0	8.0	20
Iron					
Fluoride	0.0	0.0	0.0	0.1	0.4
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.0	0.0	0.2	0.2	0.2
Boron	0	0	20	60	80

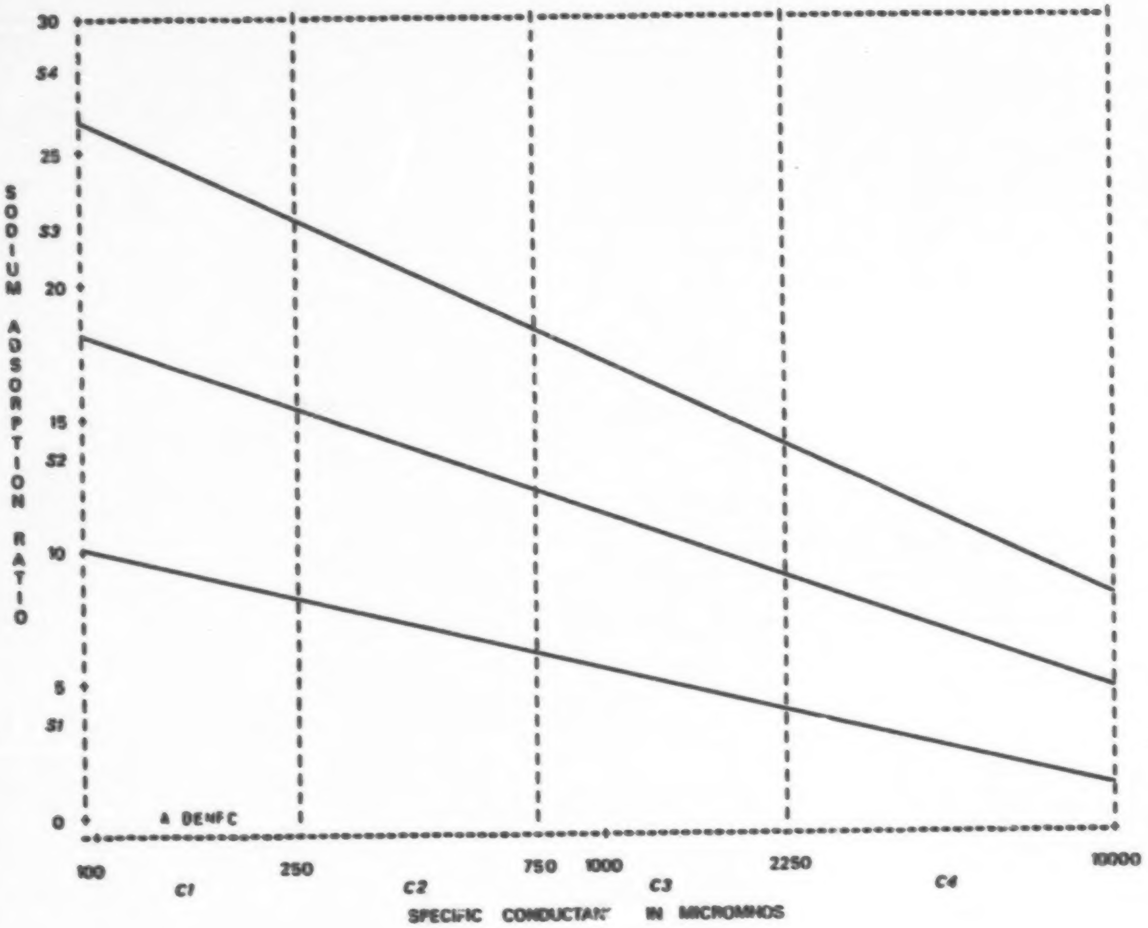
CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BARON FORK AT ELDON, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=BARON FORK AT ELDON, OK



IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,   C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS, B = 2 OBS, C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=BARON FORK AT ELDON, OK



BEST DOCUMENT AVAILABLE

ILLINOIS RIVER BASIN

07195500 - Illinois River near Watts, Okla.

LOCATION.--Lat 36°07'48", long 94°34'12", in NE¼ sec.18, T.19 N., R.26 E., Adair County, at bridge on U.S. Highway 59, 1.5 mi north of Watts, 4.5 mi downstream from Cincinnati Creek, and at mile 106.2.

DRAINAGE AREA.--635 mi^2.

PERIOD OF RECORD.--1955 to 1961, 1963, 1969 to 1973, 1976 to 1978.

WATER TYPE.--The water was calcium carbonate/bicarbonate type throughout the range of measured specific conductance.

TREND.--Plots of hardness, chloride, and sulfate concentrations versus time show that the most recent samples, post 1975, may be less concentrated than the earlier samples. However, the Spearman's rhos for these constituents at 95-percent probability level indicate no trend. Dissolved solids data were insufficient for trend analysis.

PUBLIC WATER SUPPLY.--THe average hardness was 103 mg/L and the water was moderately hard. Hardness concentrations were less than or equal to 120 mg/L for 93 percent of the hardness values. The recommended minimum pH value of 5.0 was exceeded by 1 percent of the pH values and the recommended maximum pH value of 9.0 was also exceeded by 1 percent of the pH values. No toxic metal data were available. Because of the occurrence of high and low pH values, the suitability of this water for use as a public supply may be questionable.

IRRIGATION.--The salinity hazard ranged from low to medium with 74 percent of the samples having a low salinity hazard. The sodium hazard was in the low class for all SAR values. The data indicate that boron phytotoxic effects should not occur.

07195500 - Illinois River near Watts, Okla.--Continued

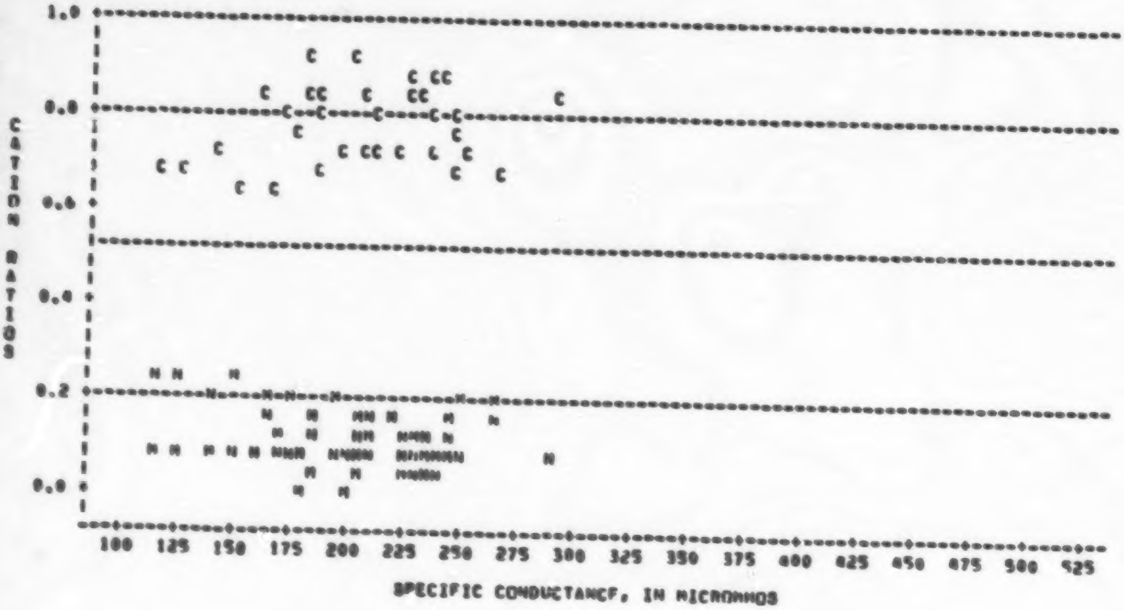
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	212	231	117	500	45	1.59	8.68
Dissolved solids	49	137	86	196	18	.38	1.94
pH	207	7.9	3.2	9.3	0.6	-2.46	13.91
Total hardness	151	103	48	147	17	-.40	.96
Chloride	155	8.3	1.0	25	3.7	1.61	4.55
Sulfate	90	9.6	1.0	44	7.4	2.04	5.77
Iron	0						
Fluoride	21	0.0	0.0	0.5	0.1	3.73	15.20
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	85	0.2	0.1	0.4	0.1	.34	-.66
Boron	12	106	40	160	40	-.46	-1.35

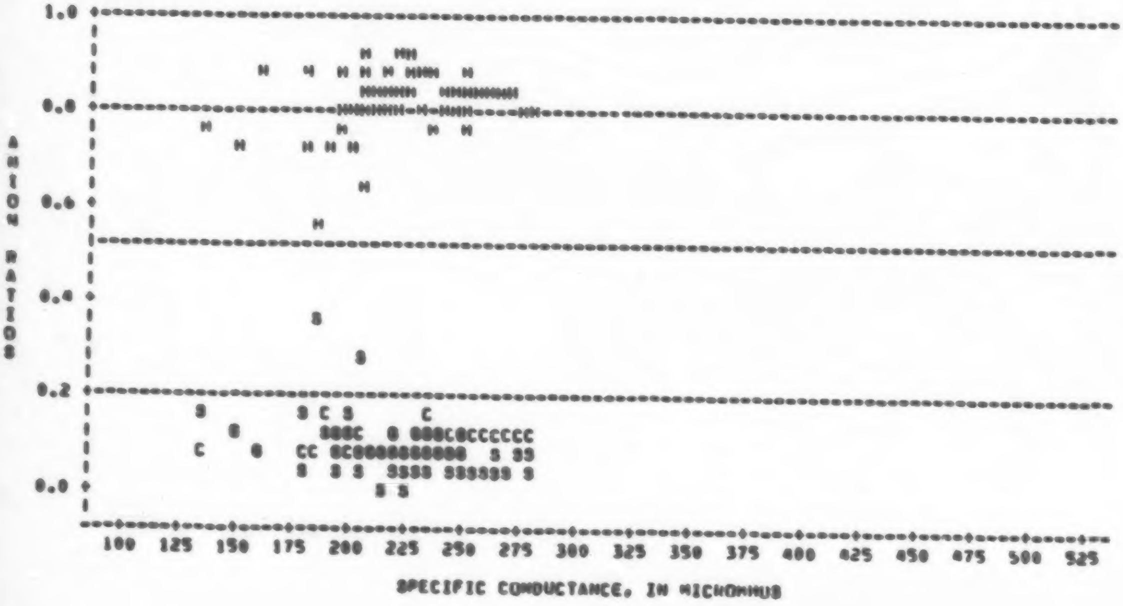
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	184	205	229	251	273
Dissolved solids	118	124	134	148	156
pH	7.0	7.5	7.9	8.1	8.3
Total hardness	82	92	106	112	120
Chloride	4.2	6.0	7.5	9.9	12
Sulfate	2.3	4.4	8.4	11	17
Iron					
Fluoride	0.0	0.0	0.0	0.0	0.1
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.1	0.2	0.2	0.3	0.4
Boron	42	60	110	135	140

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ILLINOIS RIVER NR WATTS, OK



ANION RATIO PLOT
N IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ILLINOIS RIVER NR WATTS, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD.  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=ILLINOIS RIVER NR WATTS, OK
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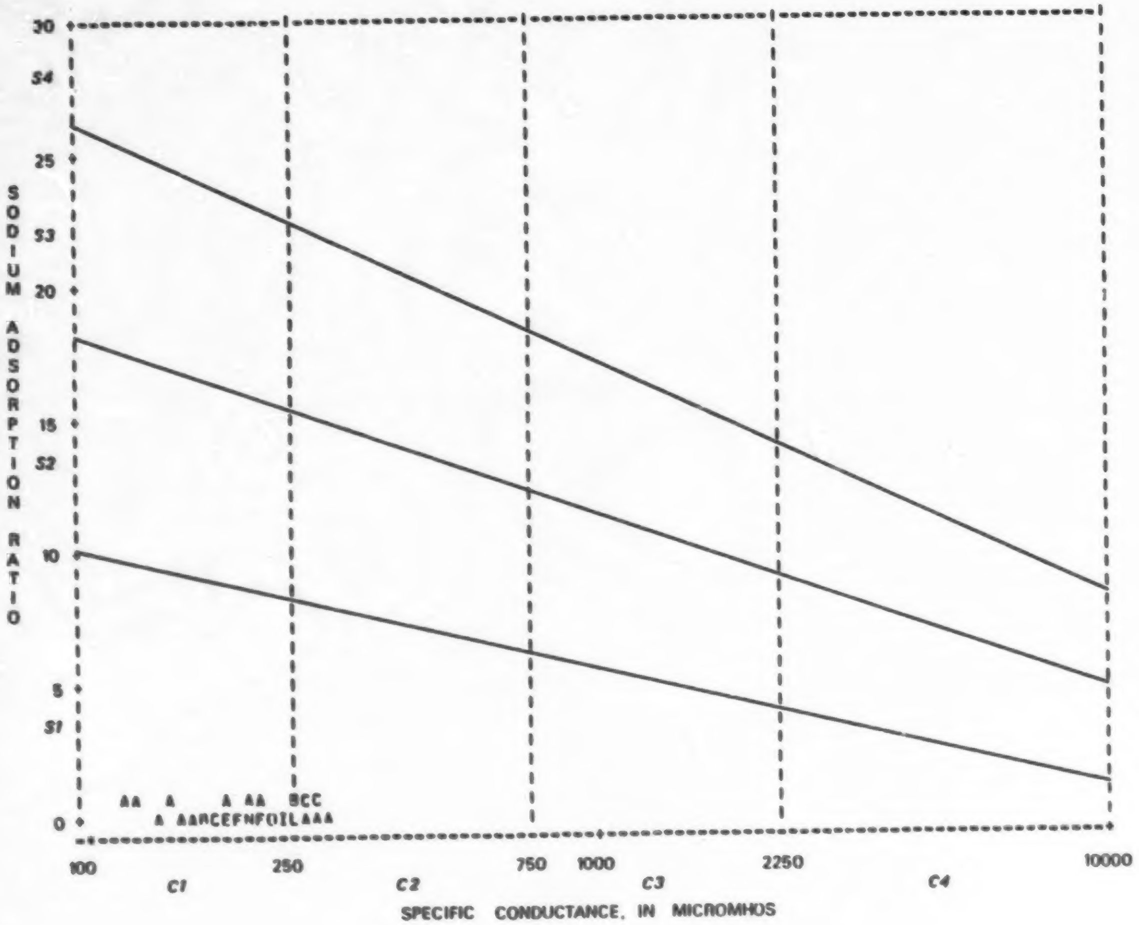


ILLINOIS RIVER BASIN

07196500 - Illinois River near Tahlequah, Okla.

LOCATION.--Lat 35°55'17", long 94°55'15", in SE¼ sec.26, T.17 N., R.22 E., Cherokee County, at bridge 0.2 mi downstream from U.S. Highway 62, 2.2 mi northeast of Tahlequah, 6.5 mi upstream from Baron Fork, and at mile 55.8.

DRAINAGE AREA.--959 mi^2.

PERIOD OF RECORD.--1960 to 1961, 1976 to 1978.

WATER TYPE.--The water was calcium carbonate/bicarbonate type throughout the range of measured specific conductance.

TREND.--The current period of record is insufficent, less than 5 years, to perform the analysis for trend.

PUBLIC WATER SUPPLY.--The average hardness was 92 mg/L and the water was moderately hard. Hardness concentrations 120 mg/L or less occurred for 97 percent of the hardness values. None of the constituents exceeded their recommended maximum concentrations. No toxic metal data were available. Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to medium with 96 percent of the samples having a low salinity hazard. The sodium hazard was in the low class for all SAR values. Data were inadequate to assess whether any boron phytotoxic effects might occur.

07196500 - Illinois River near Tahlequah, Okla.--Continued

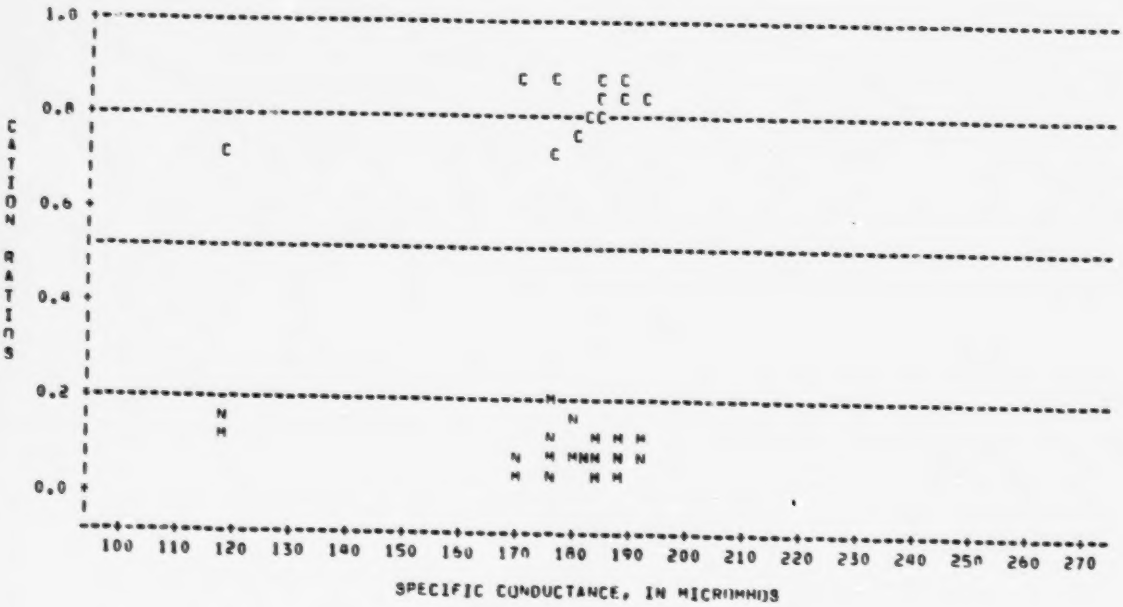
UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	72	205	119	270	30	-.02	-.23
Dissolved solids	17	105	86	120	9.0	-.21	-.34
pH	72	7.6	6.8	8.5	0.4	.00	-.94
Total hardness	59	92	46	136	13	.25	4.06
Chloride	67	10	1.0	74	13	4.13	17.67
Sulfate	41	10	1.0	61	10	3.13	13.10
Iron	0						
Fluoride	10	0.2	0.0	0.6	0.2	1.08	.15
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	16	0.2	0.1	0.4	0.1	1.55	2.28
Boron	1	90					

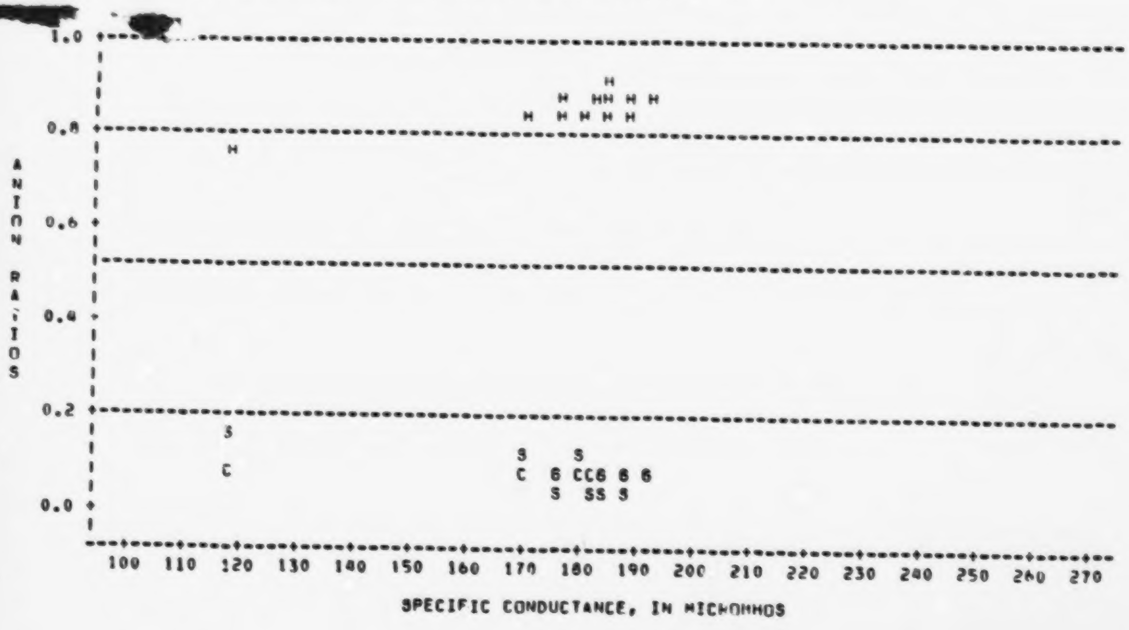
FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	166	184	199	225	242
Dissolved solids	94	98	102	113	116
pH	6.9	7.1	7.6	7.8	8.1
Total hardness	80	84	89	96	105
Chloride	4.1	5.0	6.5	9.4	14
Sulfate	2.7	4.2	6.6	11	20
Iron					
Fluoride	0.0	0.0	0.0	0.2	0.3
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.0	0.0	0.1	0.2	0.3
Boron					

CATION RATIO PLOT
N IS SODIUM ION RATIO, C IS CALCIUM ION RATIO, M IS MAGNESIUM ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ILLINOIS RIVER NR TAHLEQUAH, OK



ANION RATIO PLOT
H IS CARBONATE/BICARBONATE ION RATIO, C IS CHLORIDE ION RATIO, S IS SULFATE ION RATIO
STATION NAME OR LOCAL IDENTIFIER=ILLINOIS RIVER NR TAHLEQUAH, OK



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IRRIGATION DIAGRAM
C1 AND S1 ARE LOW HAZARD,   C2 AND S2 ARE MEDIUM HAZARD
C3 AND S3 ARE HIGH HAZARD,  C4 AND S4 ARE VERY HIGH HAZARD
A = 1 OBS,  B = 2 OBS,  C = 3 OBS
STATION NAME OR LOCAL IDENTIFIER=ILLINOIS RIVER NR TAHLEQUAH, OK
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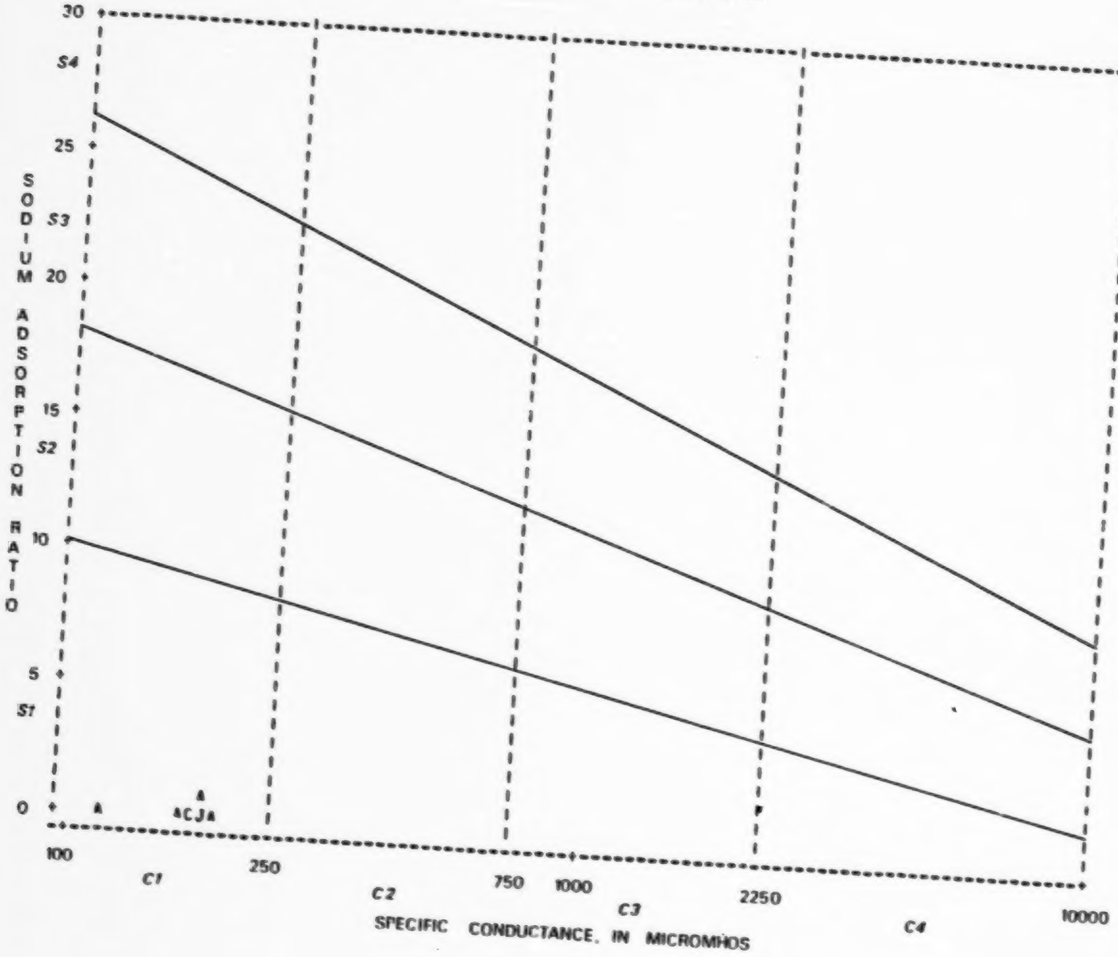

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ILLINOIS RIVER BASIN

07198000 - Illinois River near Gore, Okla.

LOCATION.--Lat 35°34'23", long 95°04'07", in NE¼SW¼ sec.27, T.13 N., R.21 E., Sequoyah County, on right bank 4.3 mi downstream from Tenkiller Ferry Dam, 4.5 mi northeast of Gore, and at mile 8.5.

DRAINAGE AREA.--1,626 mi^2.

PERIOD OF RECORD.--1948 to 1952, 1954 to 1978.

WATER TYPE.--The water was calcium carbonate/bicarbonate type for specific conductance less than 400 umhos, which occurred in 98 percent of the samples. Data were inadequate to determine water type for specific conductance greater than 400 umhos.

TREND.--Plots of dissolved solids, hardness, sulfate, and chloride concentrations versus time did not indicate any trend. However, the Spearman's rhos for hardness and dissolved solids at the 95-percent probability level show the presence of trends of decreasing concentration. The Spearman's rhos at the 95-percent probability level for sulfate and chloride indicate no trend.

PUBLIC WATER SUPPLY.--The average hardness was 84 mg/L and the water was moderately hard. Hardness concentrations were equal to or less than 120 mg/L for 99 percent of the hardness values. The recommended maximum chloride concentration of 250 mg/L was exceeded by less than 1 percent of the chloride values. No toxic metal data were available Based on the data, this water should be suitable for use as a public supply.

IRRIGATION.--The salinity hazard ranged from low to high with 95 percent of the samples having a low salinity hazard. The sodium hazard was in the low class for all SAR values. The data indicate that boron phytotoxic effects should not occur.

07198000 - Illinois River near Gore, Okla.--Continued

UNIVARIATE STATISTICS

CONSTITUENT	N	MEAN	MIN	MAX	STD	SKEW	KURT
Specific conductance	524	204	86	2200	129	11.11	145.93
Dissolved solids	386	114	40	740	39	11.21	169.03
pH	390	7.7	6.3	8.5	0.4	-.69	.45
Total hardness	389	84	33	300	18	5.69	63.67
Chloride	400	11	1.2	300	18	11.64	174.78
Sulfate	418	8.6	3.0	130	6.8	14.17	251.56
Iron	0						
Fluoride	116	0.1	0.0	0.5	0.1	1.56	3.28
Arsenic	0						
Cadmium	0						
Chromium	0						
Lead	0						
Mercury	0						
SAR	313	0.3	0.1	4.2	0.3	8.25	92.19
Boron	102	94	0	540	107	1.82	4.00

FREQUENCY DISTRIBUTION

CONSTITUENT	PERCENTILE CONCENTRATION				
	10th	25th	50th	75th	90th
Specific conductance	157	171	190	210	230
Dissolved solids	92	100	111	123	133
pH	7.1	7.5	7.7	8.0	8.2
Total hardness	69	76	84	92	97
Chloride	3.8	4.8	6.6	11	18
Sulfate	4.9	6.2	7.6	10	12
Iron					
Fluoride	0.0	0.0	0.1	0.1	0.2
Arsenic					
Cadmium					
Chromium					
Lead					
Mercury					
SAR	0.1	0.2	0.2	0.3	0.4
Boron	0	9	60	134	208

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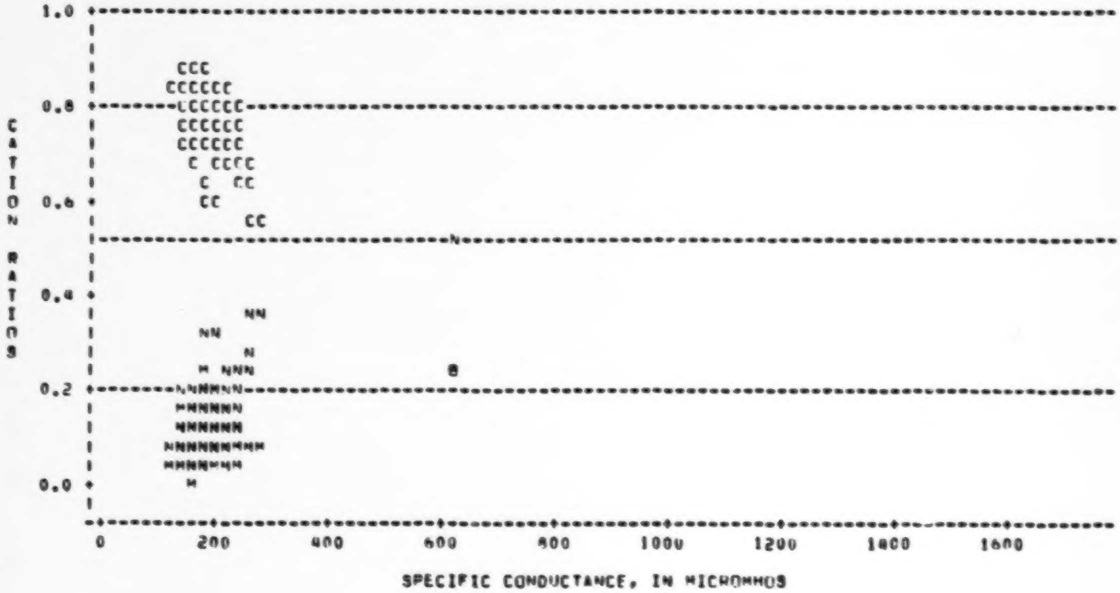

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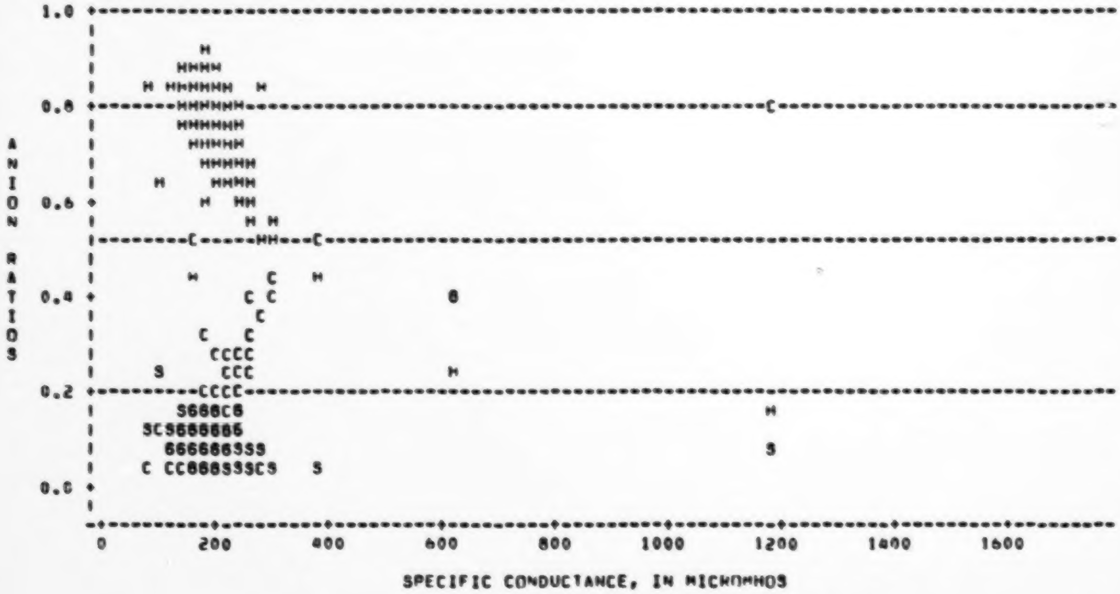

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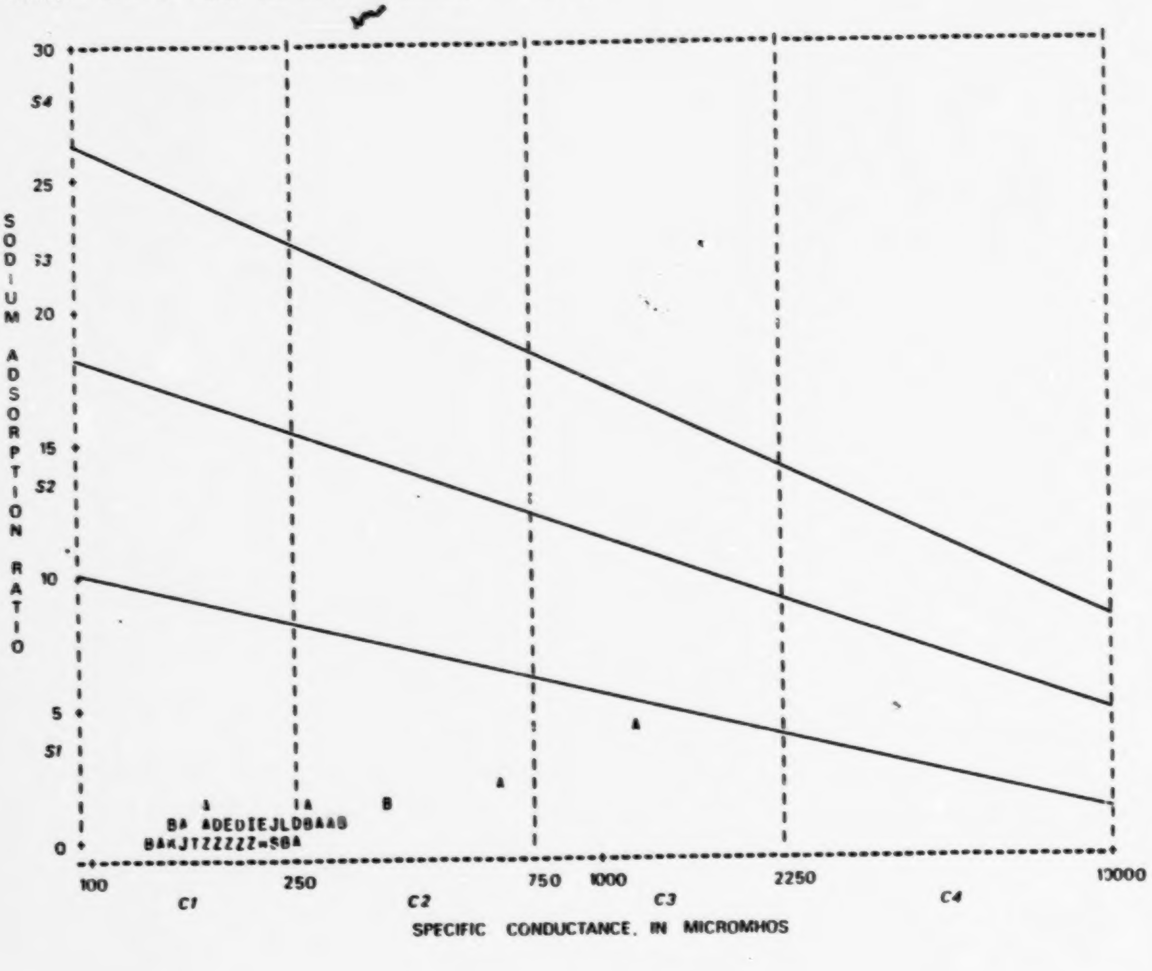

Table 3.--List of stations in downstream order

NUMBER	STATION NAME	PAGE
07146500	Arkansas River at Arkansas City, Kan	22
07152350	Red Rock Creek near Red Rock, Okla	112
07512400	Salt Creek near Shidler, Okla	120
07152500	Arkansas River at Ralston, Okla	27
07153000	Black Bear Creek at Pawnee, Okla	68
07164400	Arkansas River at Sand Springs Bridge, near Tulsa, Okla	31
07164500	Arkansas River at Tulsa, Okla	35
07165500	Polecat Creek below Heyburn Reservoir, near Heyburn, Okla	96
07165510	Polecat Creek near Jenks, Okla	100
07165520	Arkansas River at Bixby, Okla	39
07165570	Arkansas River near Haskell, Okla	43
07165610	Arkansas River at Muskogee, Okla	47
07170950	Verdigris River near South Coffeyville, Okla	196
07171000	Verdigris River near Lenapah, Okla	200
07171230	Salt Creek near Alluwe, Okla	188
07171240	Lightning Creek near Alluwe, Okla	180
07171400	Verdigris River near Oologah, Okla	204
07171405	Verdigris River above Caney River, near Claremore, Okla	208
07173000	Caney River near Hulah, Okla	148
07174150	Cotton Creek near Copan, Okla	168
07174200	Little Caney River below Cotton Creek, near Copan, Okla	184
07174500	Caney River at Bartlesville, Okla	152
07174600	Sand Creek at Okesa, Okla	192
07174700	Caney River near Ochelata, Okla	156
07175500	Caney River near Ramona, Okla	160
07175550	Caney River near Collinsville, Okla	164
07176000	Verdigris River near Claremore, Okla	212
07176350	Bird Creek near Barnsdall, Okla	132
07176455	Birch Creek near Barnsdall, Okla	128
07176500	Bird Creek at Avant, Okla	136
07176770	Hominy Creek near Hominy, Okla	172
07177000	Hominy Creek near Skiatook, Okla	176
07177500	Bird Creek near Sperry, Okla	140
07178050	Bird Creek near Catoosa, Okla	144
07178600	Verdigris River near Inola, Okla	216
07178620	Verdigris River at Newt Graham Lock and Dam, near Inola, Okla	220
07178670	Verdigris River near Okay, Okla	224
07185000	Neosho River near Commerce, Okla	240
07188000	Spring River near Quapaw, Okla	272
07188500	Lost Creek at Seneca, Mo	236
07189000	Elk River near Tiff City, Mo	232
07190500	Neosho River near Langley, Okla	244

Table 3.--List of stations in downstream order--Continued

NUMBER	STATION NAME	PAGE
07191000	Big Cabin Creek near Big Cabin, Okla..........................	228
07191200	Spavinaw Creek near Row, Okla..................................	268
07191500	Neosho River near Choteau, Okla................................	248
07192000	Pryor Creek near Pryor, Okla...................................	256
07192030	Pryor Creek at Elliot Street Bridge, near Pryor, Okla..........	260
07192060	Pryor Creek below Sulfur Creek, near Pryor, Okla...............	264
07193500	Neosho River below Fort Gibson Lake, near Fort Gibson, Okla....	252
07194550	Arkansas River at Webbers Falls, Okla..........................	51
07195500	Illinois River near Watts, Okla................................	284
07196500	Illinois River near Tahlequah, Okla............................	288
07196900	Baron Fork at Dutch Mills, Ark.................................	276
07197000	Baron Fork at Eldon, Okla......................................	280
07198000	Illinois River near Gore, Okla.................................	292
07245500	Sallisaw Creek near Sallisaw, Okla.............................	116
07246000	Sans Bois Creek near Keota, Okla...............................	124
07246400	Arkansas River at R.S. Kerr Lock and Dam, near Sallisaw, Okla..	55
07246500	Arkansas River near Sallisaw, Okla.............................	59
07246600	Cache Creek near Cowlington, Okla..............................	76
07247000	Poteau River at Cauthron, Ark..................................	104
07247500	Fourche Maline near Red Oak, Okla..............................	80
07248500	Poteau River near Wister, Okla.................................	108
07249200	Brazil Creek near Panama, Okla.................................	72
07249400	James Fork near Hackett, Ark...................................	84
07249410	James Fork near Williams, Okla.................................	88
07249800	Lee Creek near Short, Okla.....................................	92
07250500	Arkansas River at Van Buren, Ark...............................	63

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